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THE FOUNDRY

PUBLISHED MONTHLY BY

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CLEVELAND, OHIO.

ESTABLISHED 1874

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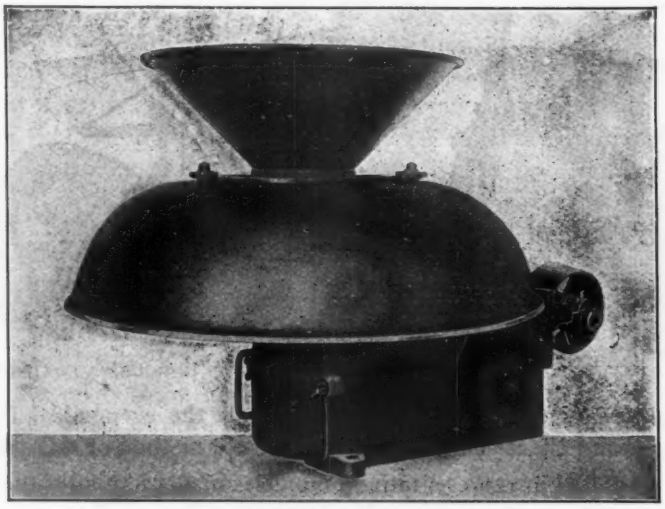

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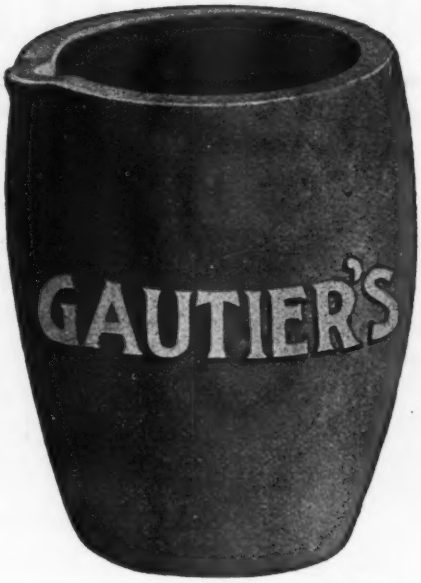

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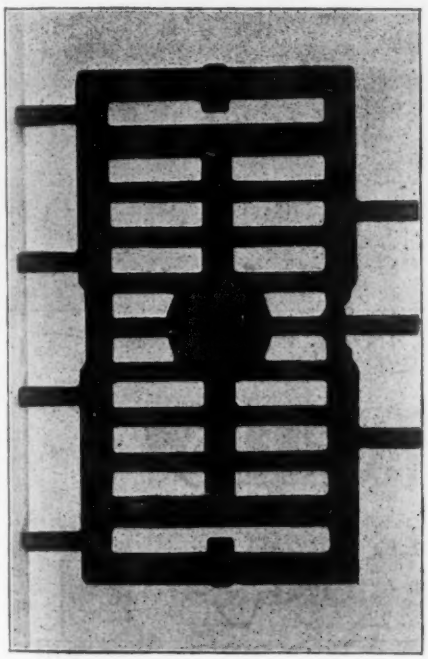

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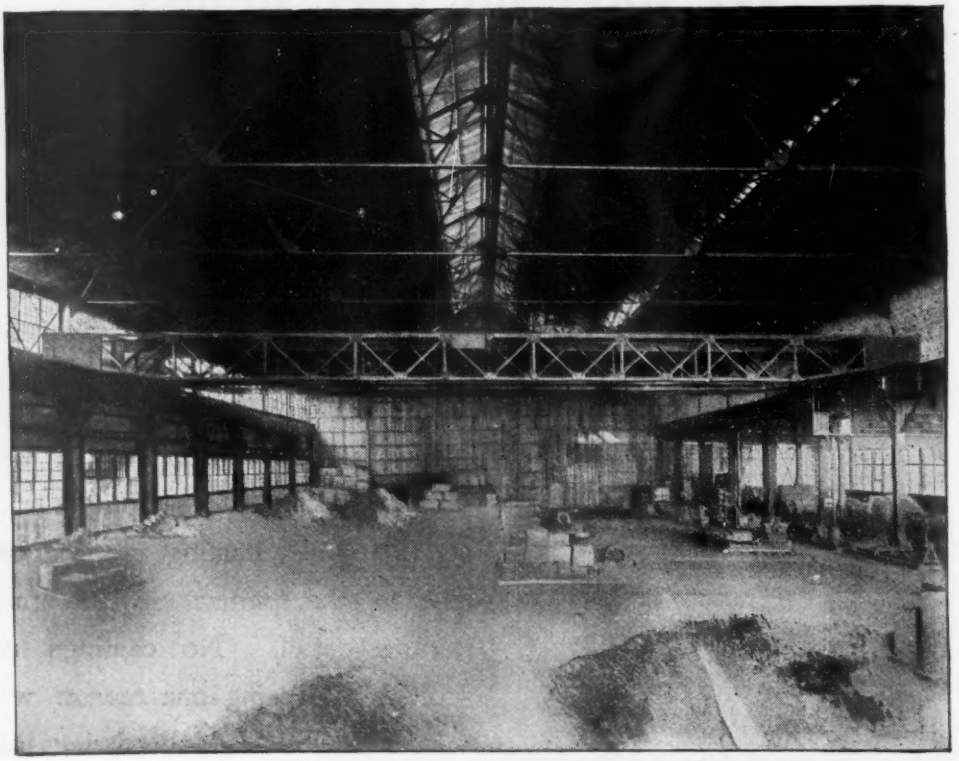

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THE FOUNDRY

Vol. 27, No. 3. *CLEVELAND, OHIO, NOVEMBER 1905.* *Whole No. 159*

Foundry Department of the Olds Motor Works, Lansing, Mich.

This foundry is operated under the supervision of the Olds Motor Works, and furnishes castings for the Olds Motor Works, for the Olds Gas Engine Co. and for the American Suction Gas Producer Co. These three plants, together with the foundry, are all located on the same tract of ground. It will readily be seen that to supply this broad demand must necessitate careful work in the foundry. There are gas engine cylinders and engines of all kinds, from the small motor engines to gas engines of several hundred horse-power; besides all of the other work which has to be gotten out for the equipment which accompanies the various installations manufactured in the three plants. The foundry building proper is 70 x 400 ft. This is divided into two bays—the center bay extending the entire length of the plant, and the side bay being cut off in the center by the cupolas and other equipment. There are also several rooms used for special purposes and a small molding bay on the side opposite the cupolas. The main floor of the foundry is used for putting up the heavier work, while the side floors are equipped for the lighter work.

MAIN BAY OF FOUNDRY.

Several molding machines are used for various classes of work, including two pairs of Pridmore machines specially fitted for making gas engine fly wheels; one Rowland stripping plate machine; three Delano machines; one roll-over molding machine; two Draper Tabor machines, and several Adams' sqeezers. The machines are fitted up specially for the work for which each is intended, and in all cases where a large amount of duplicate work is to be made, iron flasks are used.

As in all foundries making gas engine work,

OLDS MOTOR WORKS FOUNDRY.

SYMBOL..... PART..... RECORD OF.....

PIECES MADE	TIME HRS.	TIME MIN.	RATE	TOTAL COST	AVERAGE COST PER PIECE	MAN'S NAME	NO.	DATE	REMARKS

FORM 2 The Foundry

the core department is one of the very important departments. This department is equipped with one hammer core machine and with Hanna shaking screens. For mixing the facing sand in the foundry a Battle Creek sand sifter is used. All old core prints or stubbed ends of cores are saved and put into a grinding mill where they are ground up and the sand saved for use in the regular mixture.

The majority of the cores are made on benches close to the core oven. There are three ovens—or rather two ovens—one of which is divided into two parts. The oven used for the larger cores is fitted with three cars, while the smaller oven is fitted with shelves in the front and at the back end with a revolving reel carrying shelves, upon which the core plates are placed. A great deal of attention has been given to the making of accurate metal core boxes for producing the integrate jackets and port cores required for the engine cylinders.

The melting equipment consists of two cupolas—one 36 in. in diameter inside of the lining, and the other 56 in. in diameter inside of the lining. The iron is stored in the yard adjoining the cupolas and the coke either in the yard or in bins at one side of the yard.

FOUNDRY RECORD.

SYMBOL..... NAME.....

OLDS MOTOR ORDER NO..... DATE DELIVERED.....

ORDER NO. DATE ORDERED

ORDER	DELIVERED DATE	DELIVERED AMT.	BALANCE	FORWARDED	DELIVERED DATE	DELIVERED AMT.	BALANCE

FORM 1 The Foundry

The blast for the cupolas is furnished by Connersville blowers, driven by electric motors.

One of the most interesting pieces of equipment about the plant is the provision for drying small and medium-sized ladles. All of the ladles, except the truck ladles, are dried in an oven similar to a core oven. This oven is situated near the base of one of the cupolas,

MOLD FOR A LARGE GAS ENGINE FLYWHEEL.

and is provided with shelves upon which the ladles may be placed while they are being dried. The argument often advanced by foundrymen in favoring the old method of kindling a fire, is that they have a great deal of kindling resulting from the pattern shop and that they might just as well as not use it up. These men fail to consider the fact that while they are using this kindling they are paying wages to the men for building a number of small bonfires that they are all realizing a very small amount of heat, and worst of all are filling the foundry with smoke. The foundry is

DEFECTIVE CASTINGS REPORT. DATE

PIECES	NAME	SYMBOL	WEIGHT	MAN'S NAME	No.	CAUSE

FORM 3

a smoky place at best, but better results are always obtained when the foundry is kept as clean as possible, and hence a ladle-drying oven is certainly a very good piece of equipment to install. The oven is fired with coke and requires but a very small amount of heat. One great advantage of the oven is that the heating proceeds from the outside of the ladle toward the center, while in the case of a bonfire in the ladle the heating proceeds from the inside of the lining toward the shell. By the latter process the escaping steam must pass through the fire and hence the drying can never be as perfectly and thoroughly accomplished as with the oven.

The cleaning department is located in a room opposite the cupolas and is equipped with ten tumbling mills, most of which are of the exhaust type. A trolley hoist is provided for charging the larger pieces and removing them from the barrels.

An industrial railway system is installed throughout the plant for the handling of supplies and castings. The sand, coke, flour, seacoal and similar supplies are kept in a series of sheds 24 ft. wide and 250 ft. long, located opposite one side of the foundry. These sheds have a sufficient capacity to take care of nearly a year's supply of molding sand, so that it is never necessary to bring in a fresh supply during the winter.

The success of any foundry depends primarily upon the intimate knowledge which the man in charge has of every detail connected with the work. This detailed information can only be obtained by keeping a carefully devised

DENNISON'S G G QUALITY

MOLDERS ORDER.

Symbol

Olds Motor Order No.

Order No.

Pieces Wanted Per Day

Pieces Ordered

DATE	PIECES		MOLDERS	
	Made	Scrap	NUMBER	NAME

THIS TAG MUST REMAIN WITH PATTERN.

FORM 4 *The Foundry*

DENNISON'S G G QUALITY

CORE ORDER.

Symbol

Olds Motor Order No.

Order No.

Pieces Wanted Per Day

Pieces Ordered

DATE	PIECES MADE	CORE MAKERS	
		NUMBER	NAME

TAG MUST REMAIN WITH BOX UNTIL ORDER IS OUT.

A TAG MUST BE ATTACHED TO EACH COMPLETE BOX, OR SET OF BOXES MAKING A FULL CORE.

FORM 5 *The Foundry*

OLDS MOTOR WORKS.

Mixture for _____ *Plant*

_____ *Castings* *Date* _____ *190*____

Cost		Car No. or Pile	Brand	Lbs. per Charge	% Silicon	Lbs. Silicon	% Manganese	Lbs. Manganese	% Sulphur	Lbs. Sulphur	% Phosphorous	Lbs. Phosphorous	Total Carbon
$	Cts.												
		Total Lbs.											
		Gross Silicon, Manganese and Phosphorous and Sulphur											
		Loss by Oxidation											
		Net Silicon, Manganese Phosphorous and Sulphur											
		Mixture Analysis											
		Silicon											
		Manganese											
		Graphitic Carbon											
		Combined Carbon											
		Phosphorous											
		Sulphur											

FORM 6 *The Foundry*

set of records. The foundry records are exceedingly useful when they are kept up. In this plant a system has been adopted which requires but one clerk, but gives the foreman a close check on all of the work that is going on. When an order for a job is received the foundry record card shown in Form 1 is made out. This card is kept in a file in the foundry office, and is posted forward each day so as to show just the condition of each order. To determine the cost of the various castings the record shown in Form 2 is kept. This record also shows whether or not a man is keeping up the pace which he should. In glancing back over the records, the writer was very much interested to note the way in which the foreman had taken advantage of these records to give out the work to the men who could produce it at the least expense, and there were many cases which showed how a system of this kind may pay all the expense for a month's work and cards by the saving effected upon a single order; the saving being made by a slight shift or change in the method of carrying on the work.

The defective castings are handled separately, the blanks taking care of these being shown in Form 3. The clerk visits the cleaning department each day, fills out the blank and gives the authority to the foreman to scrap any castings rejected.

For keeping track of the work while in the shop, a tag is attached to each pattern or core box when the order is sent onto the floor. The tag which accompanies the pattern is shown in Form 4, and that which accompanies the core box in Form 5. Whenever castings are destroyed it is necessary to issue a new order to replace the defective ones.

A great deal of trouble was experienced formerly in holding the mixture uniform. All of the iron was analyzed and the man in charge

OLDS MOTOR WORKS MELTING RECORD ..... 190 ..... CUPOLA NO. .....

CHARGE	WOOD	COKE	FLUX	HOME SCRAP: HARD	HOME SCRAP: SOFT	FOREIGN SCRAP	STEEL SCRAP	PIG PILE	PIG PILE	PIG PILE	PIG PILE	PIG PILE	PIG PILE	PIG PILE	ESTIMATED ANALYSIS: % BL.	% MAN.	% SUL.	% PHOS.	% C.C.	% G.C.	CHECK ANALYSIS BY: % BL.	% MAN.	% SUL.	% PHOS.	% C.C.	% G.C.	NUMBER
1																											
2																											
3																											
13																											
14																											
15																											
TOTALS																											

RATIO OF FUEL TO IRON

BLAST ON

BOTTOM DROPPED

CUPOLA CREDITS

	LBS.	TEST BAR RECORD: CYLINDER IRON BAR	BREAK	DEFLECTION	SHRINKAGE	REGULAR MIXTURE BAR	BREAK	DEFLECTION	SHRINKAGE	REMARKS
PIGS										
SPRUE						1				
DEFECTIVE		1								
COKE						2				
		2								
						3				
		3								
						4				
		4								

The Foundry

FORM 7

Stub left here for binding

of the cupola would be given his charging directions. The cupola record would come back very nicely made out, but for some reason the castings would vary. The principal trouble with the cupola record was that every charge was said to contain exactly the number of pounds required. The difficulty was finally solved by sending the foundry clerk to the top house to check all weighing and to keep the record himself. By changing one piece of scrap or pig for another it was possible to come very close to the required weights, and if one ingredient of a charge was varied slightly, an attempt was made to vary the others accordingly, so as to keep the mixture as near uniform as possible. When putting any class of work into a foundry the desired analysis is first decided upon, and then the blank shown in Form 6 filled out. After a mixture for 100 lbs. or one ton has been figured out a mixture for any other size of charge can be readily calculated by multiplication or division. Of course, the records kept on Form 6 are only for the different classes of castings to be made. The daily cupola record is kept on the sheet shown in Form 7. The clerk fills in the portion in the upper left hand part of the sheet at the time the weights are made on the charging platform. The estimated analysis can be filled in from the records already calculated on Form 6, and will not need to be entered every day when a standard line of work is being made. The keeping of an accurate cupola record of this kind tends to saving in a number of ways. First, the uniform results obtained in the mixture cut down the loss of bad castings to the minimum, as if the mixture can be held uniform any loss must be due to molding or core making. Second, a careful checking of everything that goes into the cupola tends to keep the melting ratio constant so that an excess of coke is never shoveled in just for luck, as is usually the case when the charging is left to laborers.

The actual analysis of the castings is entered in the upper right hand corner of Form 7 as the results are received from the chemist. It is not necessary to make a complete analysis every day, but silicon should be determined every day.

FIG. 1. THIRTY TON CHARGE IN A FORTY TON FURNACE. NOTE THE IRON PILED IN THE FLUE ON THE RIGHT.

OPERATION OF AIR FURNACES.

BY L. G. BLUNT.

Method of Making Up the Bottom.

The bottoms of these furnaces are usually about three feet deep and should be made of river sand. It is not put in by thin layers and glazed as in the open-hearth furnaces, but the entire depth is put in at once, being rammed at the same time. After it is built up to the desired height, loam and silica sand mixed 1:1 should be piled against the bridge wall, so as to give a 1:1 slope towards the hearth.

After each heat the slag has to be removed and a little burned sand from the chipping floor is added to give the desired level. This level should be such that the slag line is kept at the same elevation. Let the slope from the back of the stack to the tapping hole be about four inches.

Method of Calculating the Charge.

The charge may be calculated just as it is for the cupola. The difference between the analysis of the iron when charged and when tapped if one is using a long flame coal whose sulphur content is one percent and the ordinary flame is maintained, will be .3% less in silicon, .005% more in sulphur, .3% less in manganese, .2% less in total carbon and the phosphorus will remain practically the same.

All the losses can be eliminated by running with a heavy flame at all times; in other words keep on the reducing side.

In such a case the sulphur will increase about .009%.

The losses can be increased by running with an oxidizing flame. The elements will burn off in about the same proportion as above until the silicon gets down to about .5% and the manganese to about .3%; then most all of the free oxygen in the passing gases will be taken up by the carbon.

Method of Placing Metal in Furnace.

The bottom should first be covered with scrap boards, before putting in the iron, to prevent its being cut up.

Where one has to charge by hand, only solid chunks, such as rolls, hammer blocks, etc., can be used if a large percentage of scrap is needed for the mix. Where a

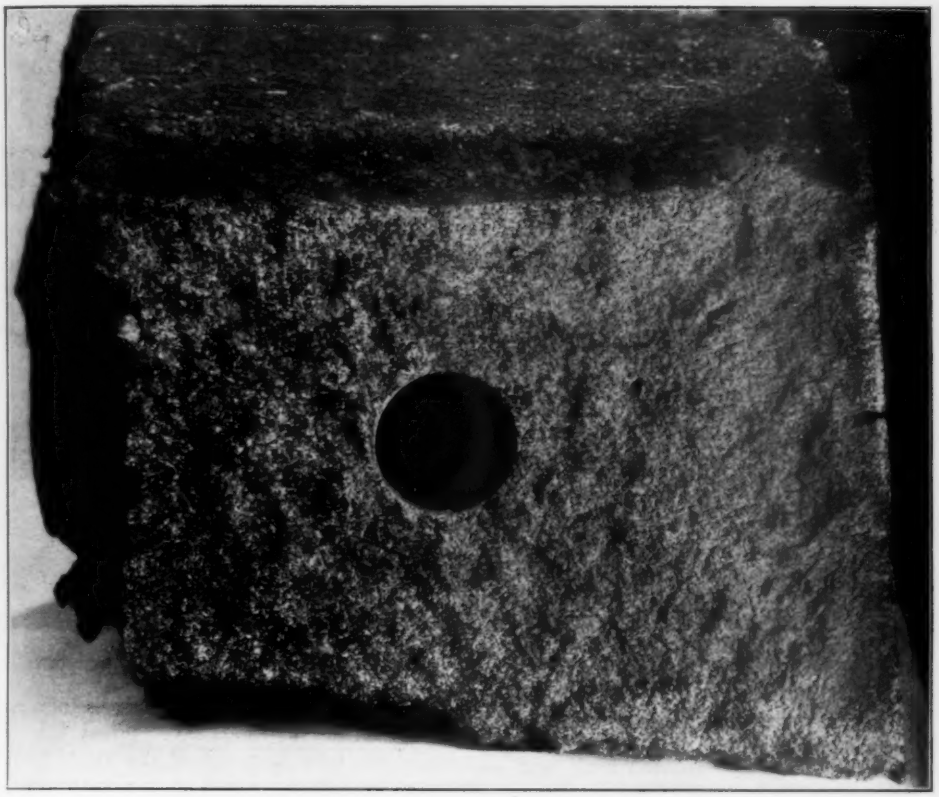

FIG 2. TEST PIECE 2 x 3″. HIGH IN TOTAL CARBON. NOTE SLIGHT CHILL AT LEFT.

charging beam is used, cored and irregular shapes are not objectionable, as the scrap can be piled up instead of all being placed on the bottom as in the former case.

If one is charging by hand it is best to place such scrap as rolls and small blocks nearest the bridge wall and the larger pieces usually about four inches from the side, opposite the puddling holes, so that they may be reached by the puddling bars in the order in which they melt.

The large pieces such as ten or twenty ton hammer blocks or irregular shapes should be placed nearer the flue, this being the best place for the former, but not often for the latter. In many cases one can only get such pieces far enough in the furnace to close the door. Where such practice necessarily exists it is not surprising that a melting ratio of two or three to one is the best that can be gotten.

Where a charging beam is used the heavy scrap should be placed on the bottom and the smaller material on top. The pig metal should be put on top of the scrap.

In the high flue furnaces it is piled from the back of the stack out to the hearth and about the entrance of the flue, in order to check the draft during the first part of the heat. If this is not done, in this type of furnace, combustion of the fuel will take place so rapidly that the iron will start to melt before the furnace gets heated up. If such be the case, the iron will run down on the bottom setting there and necessitating a second melting, which takes twice as much coal as the first.

Figure 1 shows one of the 40-ton Westinghouse Type Furnaces with a 30-ton charge in it. If this was charged to the full capacity some scrap would be seen at the bottom and the pig metal would be piled up to the roof.

The bulk of the heat should be placed between the back side of the flue and the break in the contour of the roof, in low flue furnaces, but in the high flue type it should be piled out to the point shown in Figure 1. In the low part of the furnace the metal

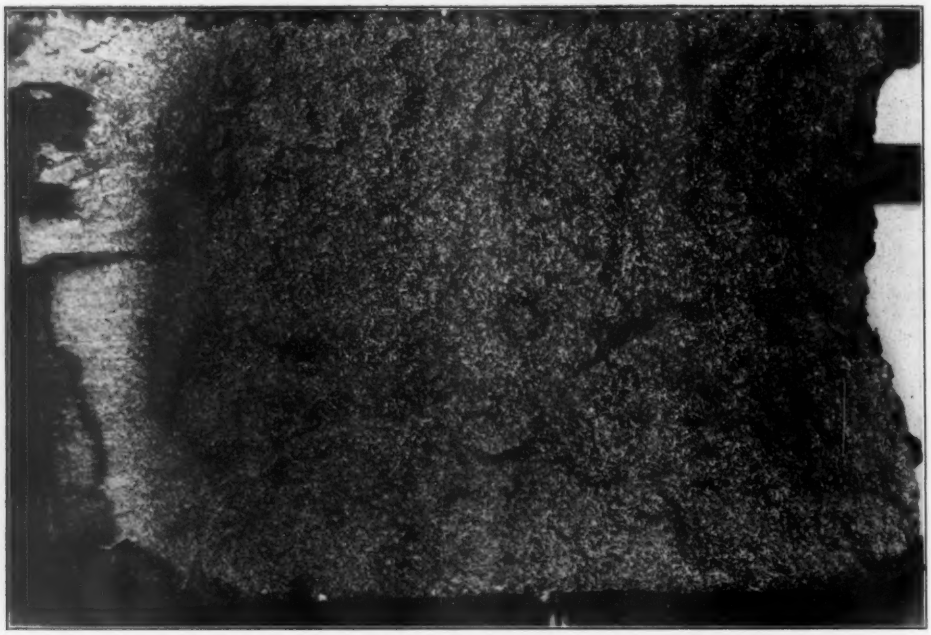

FIG. 3. TEST PIECE 2⅜ x 3½″. LOW IN TOTAL CARBON. NOTE DEEP CHILL AT LEFT.

should not take up more than half of the volume, as this allows the gases to intermingle more freely. Hence there will be more complete combustion, less oxidation of metal and better economy of fuel.

Flame Regulation.

Flame regulation is the most important part of the work and yet less can be said about it as it is almost impossible to explain flame conditions in writing.

In general it may be said that if one does not desire any reducing of the metal, the furnace should be kept full of flame at all times; some of the gases should not be supplied with oxygen until they pass out of the stack.

Where considerable refining is desired the fire should not be stoked or replenished with coal until the flame cannot be seen beyond the center of the hearth. In this case a better fuel economy will be gotten but the high priced iron which it necessitates and the greater loss in melting will over balance the extra fuel many times.

Taking of the Fracture Tests.

After all of the metal is melted and has been heated to the desired temperature the tests are taken through one of the puddling holes. For soft iron one poured on a chill is sufficient but for hard iron it is necessary to pour one in sand also. When the tests have set, take them out of the molds and let them cool in contact with air until the red color leaves, then dip them in water intermittently until they can be held in the bare hand and then break.

The silicon or total carbon may be reduced by adding iron oxide, although small steel scrap is better for the latter. In adding the oxide an excess is necessary and this excess has to be taken up by the addition of ferrosilicon or manganese, the former being best as it has a greater affinity for oxygen. These elements can be burned off by holding the metal under an oxidizing flame but this is quite slow if much of a change is required. The silicon and manganese may be increased by adding metals which contain high percentages of the elements in question.

Where an oxidizing reagent has been used it is always best to afterwards add a small amount of some reducer to free the metal from any dissolved oxides. Do not add aluminum to hard iron.

Figure II and Figure III show two test pieces. The soft one has a high carbon and the hard one is low in that element. The remaining elements are about the same in both cases. The next issue of *The Foundry*

will contain an article on the comparative cost of producing high class iron from the air furnace and from the cupola.

LOCATION OF PRESSURE GAUGE ON A CUPOLA.

The editor of *The Foundry* has referred to the writer an inquiry as to where the pressure gauge for a cupola should be located. This question is a little broader than appears on the surface, as it is necessary to determine the object of the pressure gauge. Many men will tell you that they carry a given number of ounces of blast pressure, but unless one is familiar with the cupola this means absolutely nothing. The pressure recorded by the gauge is simply the measure of the resistance offered to the blast at the point at which the gauge is located. This resistance depends first on the amount of air delivered by fan or blower; second, on the area of the tuyeres, and third, on the height of the charge in the cupola, that is, the distance from the tuyeres to the charging door. It also depends to a considerable extent upon whether the cupola is charged closed or open, and this in turn depends upon whether coarse coke and large pieces of iron or fine coke and small pieces of iron are used. Fortunately most of the cupolas now in use are made by regular foundry supply houses, and the ratio between the tuyere area and diameter of the blast pipe does not vary greatly, so that with the same character of blower and same distance from tuyere to charging door, the results in two cupolas can be compared very well. The principal use of a blast gauge, however, is to compare the results of different heats in the same cupola, and to find whether or not everything is working normally. To accomplish this the gauge should be so located that it will give a fair reading at all times. The placing of the gauge on the blast pipe itself near the cupola is not good practice, as the variation in the velocity of the air passing the pipe will introduce errors in reading. Also the blast gauge should not be placed on the wind box at a point beyond the last tuyere, as such a point would be subjected to the greatest variation in pressure, owing to the fact that near the end of the heat when the air is escaping into the furnace freely, the tuyeres will pass a greater volume and, hence, unless the wind belt is continuous about the cupola, the pressure will fall at a point farthest from the inlet. To overcome this as far as possible, some melters branch the air pipe and introduce air on each side of the wind belt. Others introduce the blast pipe tangently and use a continuous wind belt, so that the air circulates clear around the cupola shell.

In a cupola having a continous wind belt, the gauge should be placed on one side at such a point that the air rushing in from the entrance point will not blow directly against the small pipe leading to the blast gauge.

In a cupola having an old fashioned bustle pipe with a separate branch to each tuyere, the wind gauge should be situated on the bustle pipe a foot or so from the air inlet. Either one of these locations will give a fair average reading of the wind pressure and this is what is desired.

Right here it may be well to say that the amount of air necessary for melting iron is a question of pounds of oxygen, that is, cubic feet of free air. Better melting can always be accomplished by introducing this air through a comparatively wide and practically continuous tuyere at a relatively low pressure. Exceedingly high blast pressure shows that either the tuyere area is too small or that the stock is packed too closely and undue resistance is offered to the blast. Such a condition of affairs means a continuous waste of power in driving the fan to compress the air to the high pressure. Your correspondent's inquiry was not very clear, and I hope that the above general treatment of the subject will cover all of the questions which he had in mind, but if they do not, would be glad to hear from him further.

HARRY MALONE.

"Esso" Advice.

Take your eyes off the clock.

The clock doesn't need you—your work does.

When you have a hard job to do, do it. It doesn't get a bit easier by letting it wait.

Your own work requires your time, your thoughts and your energies. Let your attention center on your work and not on the other fellow's.

Ten minutes a day wasted means one hour a week. Think what that means in a factory employing 1,000 men!

Don't watch the clock.—[The Obermayer Bulletin.

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TRADE OUTLOOK.

As *The Foundry* is going to press the trade outlook is very bright. For some time there was apparent danger of a runaway market, but this danger now seems past. A large amount of pig iron has been purchased by interests in various districts. The International Harvester Co. recently placed an order for 50,000 tons, 20,000 of which went to the Sloss-Sheffield Steel & Iron Co. at about $12.75, Birmingham, for No. 2 foundry; 7,500 tons with the Virginia Iron, Coal & Coke Co. at $14, furnace, or $16.65, Chicago, and the remaining 22,500 tons were distributed among Northern furnaces, of which the Iroquois Furnace Co., of South Chicago, got a large portion. There are also a number of heavy sales reported in the Pittsburg district, among the heavy purchasers being the Sanitary Co., the Adams and one or two other local foundry companies.

There is only one important furnace interest in the South quoting $12.50 for No. 2 foundry, and very little iron can be purchased below $13, for No. 2 foundry. In the North prices are somewhat irregular. A few furnaces are still selling at $15.25 at their plants, while others are quoting $16 or higher for No. 2 foundry. In Cleveland and other markets it is difficult to obtain iron at less than $16.25, delivered.

The coke situation continues to be an important factor, and the price keeps climbing. High-grade Connellsville foundry coke is quoted at $3, and some producers ask as high as $3.50.

At this time of the year there is never as much foundry building going on as in the spring and summer; but a number of plants, or additions to plants, which have been erected during the past season, are now being started up, which will naturally increase the tonnage melted in some districts. In visiting foundries and studying the foundry situation in general, it is interesting to note the large number of small brass foundries which have started up during the past year to cater to the automobile trade.

"Wood Craft."

A year ago last March the Iron & Steel Press Co. started *The Patternmaker*. After the Iron & Steel Press Co. was united with other interests to form the Penton Publishing Co., *The Patternmaker* was sold to Mr. Geo. H. Gardner, who organized the

Gardner Publishing Co. He hired Robt. I. Clegg as editor, and has enlarged the paper, covering a much broader field and giving it the name of *Wood Craft*. The editorial columns are headed, "*Wood Craft*, With Which is Incorporated *The Patternmaker*." All interested in foundry work have found a large amount of interesting matter in *The Patternmaker*, and we feel sure that they will find far more interest in the new publication, for with its broader field and larger size it will be able to handle the subject better and to serve both the wood worker engaged in general manufacturing lines and the one engaged in patternmaking. The paper has been enlarged to standard size, 9 x 12 in., and the first number contains 54 pages of reading matter. The paper is profusely illustrated and shows very careful work both on the part of the editor and the printer.

Discussion of Specifications Adopted by the American Society for Testing Materials.

At a recent meeting of one of the foundrymen's associations several members discussed some of the specifications adopted by the American Society for Testing Materials and criticized them in some respects. These specifications have been before the American engineering public for over two years. They have been published in the proposed form in all of the leading technical journals, have been presented and discussed at the meetings of a number of engineering societies and at the meetings of a great number of local clubs. Every possible opportunity has been given for any engineer in the country to express his opinion of the proposed specifications, and the Society has invited such expressions of opinion for the guidance of those framing the different specifications. For this reason it certainly seems as though some one had slept through the meeting and now wanted to express his opinion after adjournment. It is always easier to kick about something that another has done than to pitch in and do the work, and we certainly hope that those who have no legitimate ground for complaining concerning any of the specifications will not go around kicking to outsiders about them, but look up information fortifying themselves upon every point and then take up the matter with the American Society for Testing Materials itself and try and get the specifications amended. A large number of men have given of their time and energy freely for the work thus far accomplished, and we hope that it may go on until valuable specifications have been adopted in all enginering lines so far as they can be.

For membership in the American Society for Testing Materials it costs only $5.00 per year, and any one who is interested enough in any one of the subjects to discuss it freely ought to be interested enough to take out a membership and discuss the matter in the proper manner.

Influence of the Automobile on Foundry Work.

Few people realize what changes the automobile has made in foundry practice. Automobile engines and other parts require light, strong castings of the highest possible quality. This has resulted in the development of very fine foundry practice for the production of automobile cylinders and similar parts. The complicated cores for the water jackets, ports, etc., have made it necessary for experts to devote a large amount of time to the study of core compounds and to the making of cores for this class of work. The foundry chemist has also had his troubles in producing an iron mixture suitable for automobile work.

The automobile has not improved the iron foundry alone, for the brass, bronze and aluminum foundries have received their share of trade from this source. For the production of brass fittings, brass and bronze bearings, etc., a large number of small brass foundries have sprung up about the principal centers in which automobiles are manufactured.

For the production of high-grade aluminum castings several companies have entered the field, making a special study of this class of work, so that now engine frames, and other supports for the operating and driving mechanism of the automobile are largely made from aluminum. High-grade aluminum castings are also used for automobile bodies.

For crank shafts, connecting rods, and other working parts, steel castings are very largely used. These castings must be of the highest possible quality, and to supply the demand a number of steel castings concerns have started making high-grade crucible steel castings. The establishment of all these classes of foundries is not only of benefit to the automobile trade, but to any one who wishes high-grade castings.

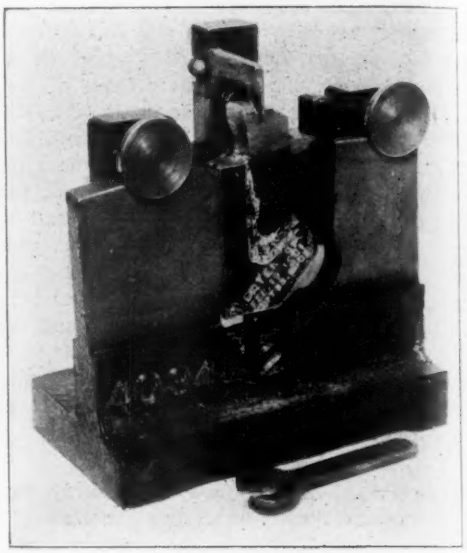
From this it is evident that the automobile has not only created a large demand for castings, but as these castings were of exceedingly high grade, has tended toward better foundry practice in all lines.

THE TAYLOR-NEWBOLD SAW.*

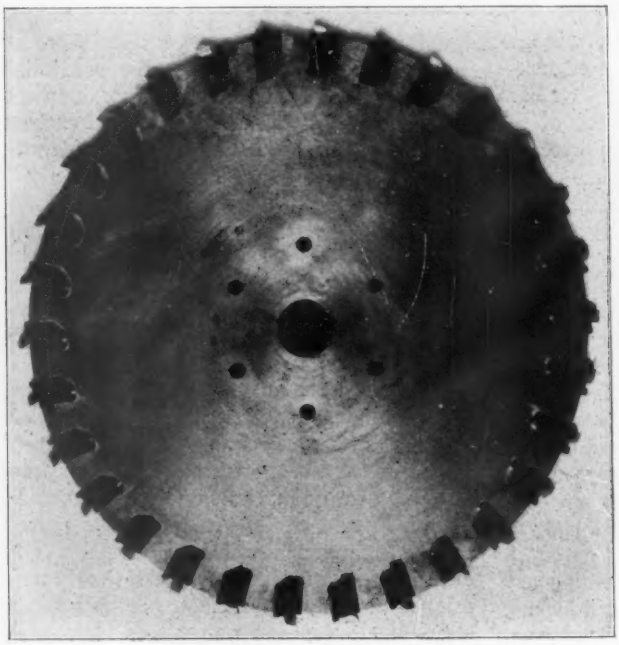
BY MR. S. NEWBOLD.

In response to a request of the secretary of this association, I am pleased to present this evening the Taylor-Newbold saw, which has aptly been described as a rotary slotter, and by all who have seen it operate, there can be no doubt that the chips produced resemble those from a heavy slotter or planing machine more than the saw dust expected from a saw. Some of the chips are shown in one of the accompanying illustrations. The saw has been referred to as a high speed saw, but high speed does not necessarily mean high cutting velocity. It refers more definitely to the results produced by the advance being made through any section of metal. This may be accomplished by a high cutting speed with a comparatively light feed, or by a very heavy feed with a slower cutting speed, and it is in the latter direction that the best results are obtained.

A great deal of attention has been given in recent years to speeds and feeds and the combination which will be most effective in removing metal; and it will generally be conceded by any one who has studied the subject that heavy feeds and slow speeds make the most rapid progress. It stands to reason that the work will be less per cubic inch of metal removed when coarse chips are produced and, therefore, less energy expended in grinding the metal to powder. This also means less surface to be traversed by the cutting edge and, hence, less wear and tear on the teeth. The form of teeth used in the saw is clearly shown in the accompanying illustrations.



GAUGE FOR SETTING TEETH.



THE TAYLOR-NEWBOLD SAW.

On such work as rough castings containing more or less sand, it is evident that a high speed with a fine feed rubbing against the gritty surface would grind the teeth away much faster than a heavy feed which would get beneath the sand pockets and cut away the metal more rapidly, but this course feed work necessitates cutting strength in the saw teeth, which is difficult to provide and which has heretofore never been so perfectly obtained as in the teeth of the Taylor-Newbold saw.

The problem has, therefore, been to design a saw with inserted teeth which should have a maximum cutting strength and a maximum resistance to abrasion. Not only this, but a saw that should provide for immediate re-

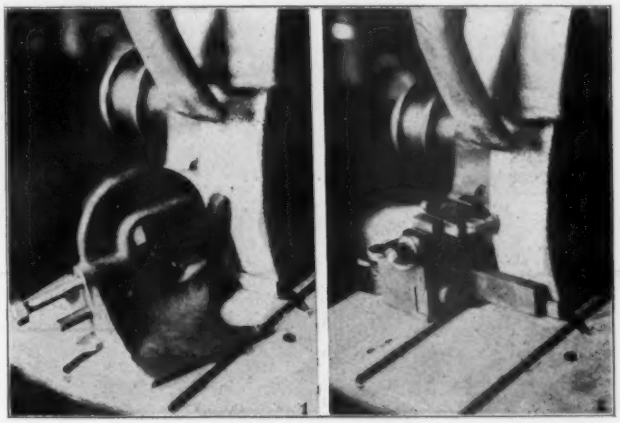
*Paper read before the Philadelphia Foundrymens' Association.

moval of broken or damaged parts in case of accident and which should protect the saw blade itself against damage so far as possible. The general construction of the saw is shown in one of the accompanying views and the detached teeth are also shown. One of the accompanying views shows a holder from which a tooth has been broken and illustrates the manner in which the holder and the wedge back of it protect the saw blade from damage.

Ordinarily inserted teeth saws are not new, but have appeared in various forms for ten years. The teeth of such saws, however, have not possessed adequate strength, and the breaking of cutters is always attended with more or less damage to the saw disc. It has, therefore, been the object in the design of this saw to provide effectively against such damage, and the experience of the last few years has demonstrated that teeth may be broken repeatedly and new teeth inserted not only without damage to the saw blade itself, but with very little delay in the operation of the saw.

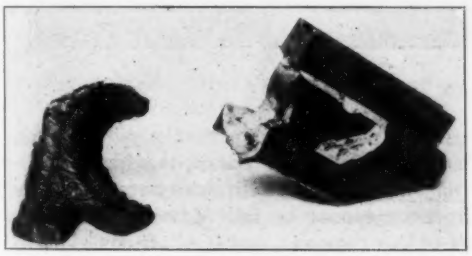
The saw consists of a steel disc rather thicker than the ordinary saw and having an even number of pockets milled about the circumference, as shown in the general view of the saw. These pockets are provided with tongues to hold the inserted teeth laterally and the bottom of each pocket is milled very accurately to the same radius from the center of the saw. The teeth consist of "U" shaped holders, in which the cutters are inserted and held by casting type metal about them. The holders are provided with set screws by which the height of the cutters can be adjusted. At the back of each holder a wedge is driven to hold it securely in place. Each cutter has a solid steel bearing behind, while the space in front, which is subjected to the least pressure is filled with type metal.

A peculiar feature of the construction is that the teeth are alternately broad and narrow, the narrow teeth being set out further than the wide teeth, so as to divide the cutting approximately between the two sets of teeth.



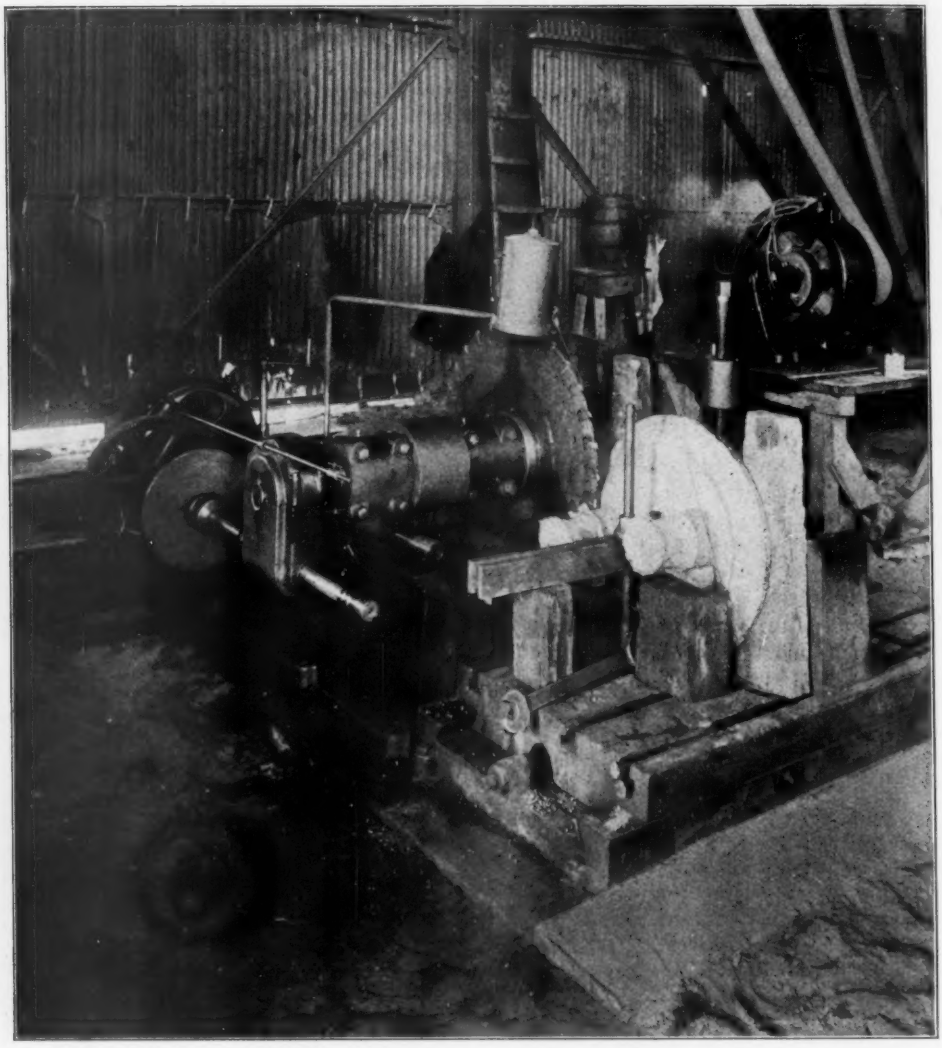
TAYLOR GRINDER FOR GRINDING CUTTERS.

After a tooth has been inserted in its holder and the type metal poured about it, the end of the cutter is ground by placing the holder in a special grinding chuck, as shown in the illustrations. A Taylor grinder is used and the teeth ground to exact form. By this means all of the wide teeth are ground exactly alike and all of the narrow teeth ground exactly alike.



CHIPS AND CUTTER HOLDER, SHOWING HOW THE METAL OF THE HOLDER PROTECTS THE SAW WHEN A TOOTH BREAKS.

The set screw in the bottom of the holder serves as an adjustment by which new teeth can be inserted in a saw and brought to exactly the same height as the other teeth with which they have to work. This adjusting is accomplished by means of the setting gauge shown in one of the illustrations. This gauge represents a section of the periphery of the saw and a small rider is adjusted to move over the top of the tooth while it is inserted in the gauge, thus enabling it to be adjusted to the proper height. By means of this gauge a set of teeth can be adjusted to uniform height ready for insertion in the saw, and when a change of teeth is necessary, the time required will be simply that necessary for knocking out the wedges, removing the old teeth and inserting the new ones. No time whatever will be lost in setting the teeth because they are al-



TAYLOR-NEWBOLD SAW AT WORK.

ready set before they go into the saw. This enables the operator to keep the saw in practically continuous service, whereas if it were necessary to take time to adjust the teeth in the saw itself serious delays would result. It is advisable in every case to have an extra set of cutters ground and adjusted ready for immediate use, and where the work is heavy and continuous two or three sets can be used to advantage.

It will be noticed that the cutters are of unusual depth and strength and that a large body of metal is provided for wear. The best high speed steel is used in the construction of the cutters to resist abrasion, and the treatment of this steel is particularly important, since it is desired to obtain the highest efficiency and the most satisfactory results. This treatment cannot be fully described in a paper of this character, and it will be sufficient to say that the Taylor-White process in its best and most effective form is used exclusively, the work having been installed under the personal supervision of Mr. Taylor himself. In fact, the life of the saw depends upon this treatment more than upon any other one thing, and the general public has very little conception of the care taken and the money expended in producing the teeth as perfectly as they can be made.

The saw itself may be regarded as an evolution, this general form having been first developed for the cutting of armor plate at the Bethlehem Steel Co.'s plant. Later a number of improvements were made which are now contained in the Taylor-Newbold saw. These improvements are all covered by broad patents, a number of which are still in the office.

One point to which special attention should be called is that the cutter holder and wedge interpose two pieces of metal between the cutter and the blade, so that the breaking of a cutter will not destroy the blade. Ordinarily when a cutter breaks it rolls down on to the blade behind it, but in this construction it simply mashes the soft holder. It may also injure the wedge somewhat. The set screw in the base of the holder is generally made of hard brass or bronze which would also crush and break, thus relieving the blade from pressure in a radial direction. When a cutter is broken the holder is immediately removed and a new cutter inserted with very little delay.

Ordinarily when a tooth breaks in a solid disc saw, the feed on the succeeding tooth is doubled and it is only a question of time until the next tooth is broken also. The breaking of two teeth throws three times the weight upon the next one, which is bound to go. Hence, the breaking of one tooth means the ultimate destruction of the saw, and the only effectual remedy is to grind off all the teeth and cut new ones. It is absolutely essential for the proper working of any saw that the teeth should be uniform in height. Any departure from this throws an undue load on the teeth and tends to their ultimate destruction. In some types of inserted tooth saws, the breaking of a cutter necessitates the removal of the blade, the insertion of a new cutter and the regrinding of the saw to bring the tooth the same height as the others.

In solid disc saws it is frequently noticed that the teeth on one side only do the cutting, by reason of imperfect grinding or setting, but in such saws the feed per tooth is necessarily very fine and one-thousandth of an inch might measure the difference between active and idle teeth. With the Taylor-Newbold saw, however, each tooth has a comparatively coarse feed, the average being as much as from one to four-hundredths of an inch. Then, too, better means are provided for better setting, and this enables the maximum load to be maintained on each tooth.

Saws are ordinarily kept in stock from 6 in. to 60 in. in diameter and larger ones made to order. To give an idea of the capacity and durability we may mention that one of the 36 in. saws after running day and night for two weeks on various steel forgings cut through without regrinding a .35 carbon steel forging 14 in. wide and 9 in. thick in 17 minutes. Another saw 40 in. in diameter ran continuously for three months on steel castings without regrinding. We do not, however, advocate such extreme usage, as either one of these saws would have done better work if it had been ground regularly.

The tremendous cutting pressure upon each tooth of this saw requires unusual precaution in holding the work. Clamps which ordinarily hold work for solid disc saws are often inadequate to hold work against a Taylor-Newbold saw, and when the work slips nothing in the world can save the saw from buckling.

The work must be held absolutely rigid and the saw must be cared for if it is to cut evenly and if side stresses due to uneven cutting are to be avoided. Either the slipping of the work or the wearing away of one side of the teeth may cause a saw to buckle, but in legitimate service we have never experienced any difficulty whatever in this way.

These saws are used largely in steel foundries, forging shops, structural works and rail mills, but there is no reason why they should not be used in gray iron foundries, particularly where there are heavy sinking heads to be cut off, and this is our principal reason for placing such a paper before the Foundrymen's Association. Steel foundries are already interested and we hope to interest iron foundries.

An important adjunct of this saw is the Taylor grinding attachment shown in the accompanying figures, by which the ends of the teeth can be accurately ground to shape. This attachment is made for use on an ordinary wet grinder of the Northampton type.

One of the accompanying illustrations shows the saw at work cutting the risers from a steel casting.

NOTE.—When the paper was presented at Philadelphia it was accompanied by a number of lantern slides, showing various applications of the saw to different classes of machines.

Goodner Bros. have purchased a plot of land of G. W. Swink, at Rocky Ford, Colo., with the object of erecting a foundry.

MOLDING A THREE WAY COCK.

BY H. J. MCCASLIN.

A three-way cock or plug valve of the design shown in Fig. 1 is in many ways a difficult casting to mold. If molded in green sand it would require a three-part

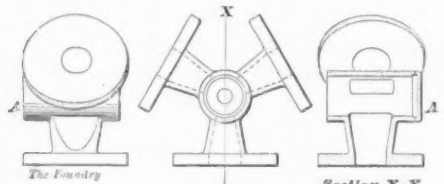


Fig. 1

flask in addition to the cores. In most cases this piece can be molded in cores more quickly and cheaper than in any other way. In Fig. 1 the central view shows a plan of the cock, the left hand figure a side view and the right hand figure a section on the line X, X. This design of valve is also sometimes made with an open

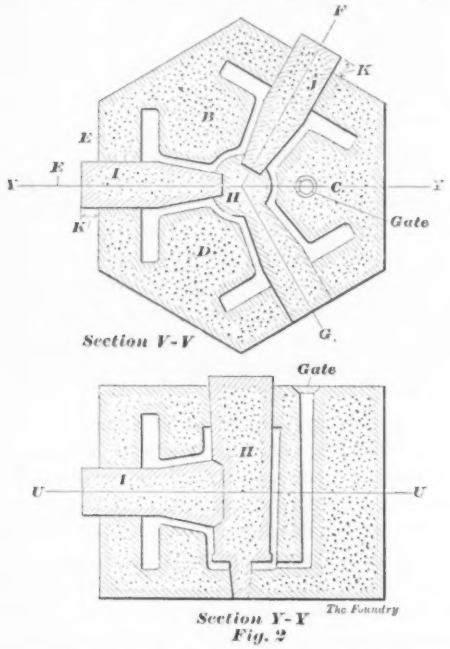


Fig. 2

bottom at A, which is subsequently covered with a plate secured to the cock. To a patternmaker or molder the various disadvantages and difficulties in connection with this job will be readily appreciated, but without stopping to discuss these we will proceed to describe one method that has proven very successful in many cases.

The cores for the mold are shown in Fig. 2. The upper view is a horizontal section taken on the line U, U, while the lower view shows a vertical section taken on the line Y, Y. The outer part consists of three cores B, C and D, which are joined on radial lines at E, F and G. The center core H and the core for the passage on the line G are made in one piece, while the cores for the passages E and F are made separate as shown at I and J.

When assembling the mold the cores C and D are placed together with the center passage core H in place with its projection for the passage core between the cores C and D. This holds the core H in place and locates it correctly. Before the core B

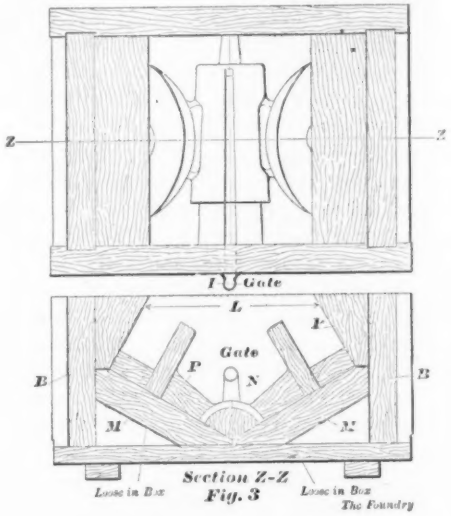


Fig. 3

is set the cores I and J must be set into the center core H and held in place until the core B is located. To assist in holding the cores I and J in place they are made long enough so that their ends project as shown at K. These projected ends may be held or blocked up, while setting the core B. When the parts have been assembled a flask is placed around the group and a backing of sand rammed in.

The core boxes are made as shown in Figs. 3, 4 and 5. The box for making the large cores B, C and D is shown in Fig. 3, the upper view being a plan and the lower view a section on the lines Z, Z. The checks L, L are made loose in the box as are also the diagonal pieces M, M, which carry the patterns P, P. When making a core

the box is rammed full of sand, the blocks L taken out and the depressions left filled in with green sand. The box is then rolled over and the main gate drawn out through the side of the box (of course the gate is only required in one of the three cores). After the gate has been drawn the frame

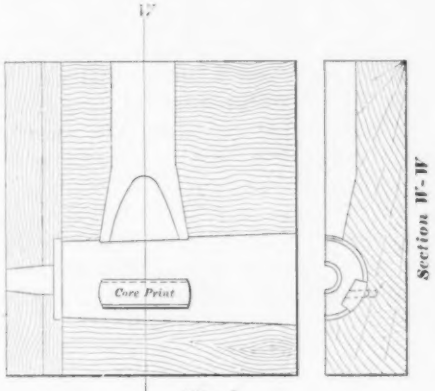


Fig. 4

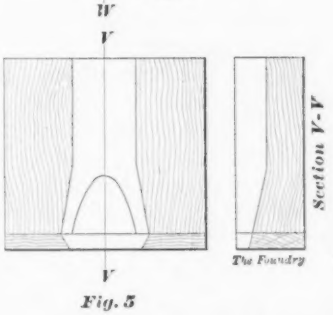


Fig. 5

is removed and the blocks M, M carrying the patterns P, P drawn. This leaves the gate N exposed to be drawn.

In order to make the center and passage core H entire as shown in the assembled mold, two half core boxes, one of which is shown in Fig. 4, will be required. The core print in the bottom of the center portion of the box is left loose to be drawn from the core after the latter has been turned over onto the core plate.

Two other half boxes are necessary for making the cores I and J shown in Fig. 2. The reason both half boxes are required for this purpose is on account of the taper of the center core H.

The Dean Stove Foundry Co., of Covington, Ky., is moving its entire plant to Newport, Ky.

PRACTICAL ALLOYING III.

Methods of Making Alloys.

JOHN F. BUCHANAN.

The importance of method in making alloys can hardly be over-estimated. Perhaps there is no industry requiring more constant vigilance, or more careful revision at the different stages of manufacture, than the production of the metallic alloys. Practical metallurgy is concerned with the smelting, refining, and alloying of the metals; these three processes are frequently interdependent, but the climax is reached in the last named, as the behavior of alloys rarely coincides with the behavior of the component metals. Owing to the many valuable properties which certain proportions of the useful metals impart to each other, the manufacture of alloys and the desire for new combinations is not likely to diminish. The advantages to be gained by alloying metals are not confined to any particular branch of metal working, but as the majority of the useful alloys are handled by the brass-founders, and we are at present more intimately concerned with the founding of metals, our survey of the manufacturing methods shall follow the routine of the foundries. The methods of preparing alloys now in vogue have been developed within the last 50 years from crude and unreliable forms of procedure into more systematic standards. Nevertheless there is no code of rules for the correct production of alloys. There can be none since the different alloys have to be made, with necessary changes, according to the nature and characteristics of the metals employed. All the metals possess much the same characteristics but in such widely varying degrees that the treatment meted out to those at one end of the scale, would be altogether unsuitable for those at the other end. The nature of an alloy cannot be determined beforehand from our knowledge of the metals.

Metals in the fluid condition obey the laws of fluids. They have a solvent power which generally increases with the temperature, but which is not limited by the fusibility of a solid metal in conjunction therewith. When a molten metal has been saturated with another metal its power of dissolving the latter may be increased by the addition of a third constituent. When a

solid dissolves in a liquid there is a change of temperature due to chemical changes effected by the molecular motions of the two bodies. Thus in making alloys, heat is sometimes absorbed, but in most cases the reaction is *exothermal,* heat being evolved. Metals which combine with the liberation of heat are in particular well suited for forming alloys.

Alloys may be prepared mechanically by compressing the powders of the metals, and electrically, by depositing the metals by means of a powerful electric current, but the most important method of alloying is by the direct fusion of the metals in a heated atmosphere.

Most metals are capable of existing in some degree of chemical combination with each other, but we know so little of the real nature of chemical affinity that alloys are generally composed experimentally, as mixtures without any special regard to chemical principles. As it has already been shown, alloys were made at first quite unconsciously by the early metal refiners. *Aurichalcum* (i. e. golden copper), was a product of nature and the secret of its manufacture could never be mislaid. Brass was originally manufactured by the cementation of calamine ($ZnCO_3$) and copper, long before the discovery of zinc in the metallic form. The ancient Greeks acquired such proficiency in preparing this alloy that the demand for Corinthian brass was greatly increased.

But the alchemists were the originators of systematic experiments in the art of alloying; and as they generally dealt with small quantities of the elements they were studying, it was easy for them to fuse the various metals in separate crucibles and bring them together by pouring them into one another. This was the first practical plan adopted by metallurgists for the manufacture of alloys; but as the number of metals entering into alloys increased, it was found more convenient to make a preliminary combination of two or more of the components, and to dissolve that in the metal forming the base of the alloy. We have a survival of this method in the manufacture of anti-friction alloys, "hardening," in this case, being the name of the preliminary alloy. Bellfounders make an alloy of copper and tin in equal proportions, called "temper," and this is used to harden the copper, and to avoid remelting the whole of the alloy. Brassfounders sometimes prepare a "mixing" metal to be used in making up alloys to a required standard. "Delta" metal is prepared by adding zinc which has been saturated with iron, to molten copper; and phosphor bronze, to be correctly made, requires a preliminary combination of phosphorus and tin, or phosphorous and copper. These are a few examples of the direct fusion methods of making alloys. Like many other industries the manufacture of alloys has been surrounded with a great amount of secrecy. The results of alloying processes have been well advertised, —but the processes themselves—not much!

It would seem as if the public needed to be impressed with the unique qualities and trade marks of certain alloys,—and patent medicines. It is quite true that the exact composition and the mode of preparation are important matters in producing uniform alloys, and while we may by chemical analysis, be able to determine the exact composition of an alloy, it may not be possible, by ordinary methods, to reproduce the physical properties of the original sample. Many celebrated metals owe their inherent virtues to a particular mode of manufacture. Alloys are sensitive compounds; as a rule they are more easily oxidized than their components, and remelting makes a remarkable difference in their physical conditions. Generally the proportions of the constituents are changed thus: Alloys containing alluminum, copper and iron, show an increase when remelted. Alloys containing zinc, tin, manganese, phosphorus, antimony and bismuth, show a decrease when remelted. Alloys containing lead, remain stationary when remelted. The difficulty of preparing alloys of definite composition is increased when old metals are combined with new to make an alloy. It is quite possible to build up alloys to any specified standard with scrap or remelted metals provided the average content of the components is known. But it should always be borne in mind that the chemical analysis of an alloy gives no information as to the method of its production. And the properties of an alloy cannot always be reproduced simply by using the published formula.

The actual capabilities of a metal are

seen in the physical tests, and as it is easier to keep to the chemical proportions than to combine the elements in the same physical condition the best results are obtained by preventing liquidation, oxidation, crystallization, or anything that would interfere with the homogeneity of the alloy. In making sound castings from almost any of the alloys—the metal should not be overheated, and as a general rule, it should be poured when it is sufficiently fluid for the work.

Prolonged melting is to be avoided except where the removal of volatile impurities is desirable. Antimony, arsenic, zinc, mercury and bismuth are sometimes removed from alloys by keeping them in a molten state for a prolonged period. Alloys are always more fusible than the mean of their constituents, and their physical properties and chemical behavior alter with every fresh addition. Metals with weak affinity generally show the characteristics of the metal present in largest quantity, and vice versa.

It often happens that two competing firms make castings from the same patterns and to the same specification. Both lots analyze within the limits of the specification, but when the castings are put to the physical tests there may be a difference of a ton in the tensile strength or 100 lbs. per square inch in hydraulic resistance—all the difference between good and bad castings—in the two lots. This can only be accounted for by the methods of selecting, melting, mixing and casting the metals. It has been understood for a long time now that the presence of a small, nay, almost insignificant quantity of an element may have a far-reaching influence on the properties of a metal or alloy.

Aluminum cannot be used in the highest quality of steel as it induces crystallization. Magnesium like aluminum is a powerful reducing agent generating great heat in forming alloys. It is sometimes added to nickel to remove traces of oxide which may be dissolved in the metal, but if any excess of magnesium is used it does not alloy with the nickel. In the same way, phosphor bronze—an alloy of copper and tin which has been fluxed with phosphorus —generally in the form of copper phosphide or tin phosphide,—may lose its best properties and be rendered worthless by a slight excess of phosphorus. Only when the impurities or foreign metals dissolve freely and become incorporated in the alloy can the founder afford to ignore them. In many cases the content of foreign elements is so very small that it cannot be reckoned as a factor in the final alloy, except by showing either better or worse results than the alloys which do not contain them.

The main points to be considered in manipulating metals for the purpose of making alloys are the fusibility, volatility, fluidity, and chemical affinity of the combining metals in the heat, and the homogeneity of the alloy in the solid condition. Some metals only combine in limited proportions. Lead is said to be capable of holding about 2 percent of zinc, copper takes up about 8 percent lead, and zinc is said to be saturated with iron at 5 percent. Since aluminum has been added to the brass founders' repertory, the difficulties of alloying have been increased. Aluminum plays havoc with any alloy which contains lead, it has great affinity for silica, therefore sprues or scrap with sand adhering must be thoroughly cleaned. If aluminum gets mixed with soft solders it destroys the adhesive or fluxing properties of the alloy.

The indiscriminate use of aluminum in alloys has done great injury to the reputation of the metal as a mixer, and hindered the usefulness of the *bona fide* aluminum alloys, particularly aluminum bronze and aluminum brass. As a deoxidizer, aluminum is a snare and a delusion, for when it comes into contact with the oxide of any other metal, and heat is applied, it displaces the oxygen of the other metal to form oxide of aluminum (Al_2O_3) and the last condition of that metal is worse than the first.

Aluminum brass alloys are correctly made in either of two ways, 1st by introducing metallic aluminum into molten brass, or 2nd, by introducing zinc into melted aluminum bronze. Repeated remeltings of this or indeed any of the brass alloys are not advisable, unless allowance is made from time to time for loss due the volatilization of zinc.

In these days of concentrated products and short cuts to fortune, it is the easiest thing in the world, (if we can believe the

story the ad writer tells) to produce alloys in definite proportions with metals which are known to be difficult to combine. Special alloys are manufactured in a highly condensed form, (like the tabloids of the pharmacist,) to meet the needs of brass-founders and to avoid palpable difficulties in the way of reducing and combining elements of widely different qualities. The introduction of ferro-manganese, ferro-aluminum, ferro-zinc, cupro-manganese, silico-copper, aluminized-zinc and phosphorized copper and tin, as intermediary alloys, has reduced the difficulties in connection with the production of complex alloys, to a minimum.

A common difficulty in making alloys is the disparity in the fusibilities of the metals. This is generally overcome in foundry practice by fusing the metal with the highest melting point first and then adding the more fusible elements in the solid condition. With brass, bronze and nearly all the copper alloys, this practice commends itself as giving the most economical and satisfactory results. But with volatile metals in conjunction with highly refractory metals, as. Zn+Fe or Sn+Pt advantage is taken of the solvent action of a metal of low fusibility when melted in contact with one of high fusibility. If zinc were introduced into molten iron the loss of zinc would be considerable, the ebullition of the iron would be dangerous and the composition of the alloy would not bear the intended proportions.

Whereas, when finely divided iron is mixed with molten zinc a definite proportion of the iron is absorbed and the two metals combine with ease. Again Platinum is so difficult to fuse as to require the aid of the electric arc or the oxyhydrogen blowpipe; but if a more fusible metal is reduced to the molten state and small quantities of platinum are gradually added, many useful platinum alloys may be produced. Nickel also is difficult to fuse by itself,—but if it is to be alloyed with aluminum or copper as in the German silver alloys, the best practice is to place the metals in the crucible in layers, with powdered charcoal between, and charge in the same manner as brass.

Very often the temperature and the order in which the metals are introduced to each other in the crucible are matters of importance. Alloys containing copper, lead, zinc and tin, are more readily made to specification if the metals are melted in that order and the metal is raised to the proper heat immediately after the last admixture.

Alloys of metals which melt below a red heat may be made by simply fusing the metals together, but combinations of volatile and readily oxidizable elements require more careful treatment. Alloys which enter into chemical combination, in atomic proportions, as $SnCu_3$ may be remelted without undergoing any change in the ratio of the constituents. Unfortunately very few alloys of practical utility can be made in atomic proportions.

Mr. Parsons, the inventor of manganese bronzes for propellers, claims that the elements in his alloys are combined in atomic proportions. "This renders the alloy much more stable than when not so combined, and if a quantity is passed through an ordinary reverberatory furnace and exposed to the action of an oxidizing flame for a considerable time, no appreciable difference is made in the composition of the alloy." This is an ideal alloy, according to the description, but the real thing has its drawbacks. Like all sluggish metals it gets more sluggish every time it is remelted, and the loss of the *combined* alloy is considerable. Besides, all metals in the molten condition absorb gases, this one included.

In melting crucible steel, the metal, as soon as it becomes liquid, is said to be "clear melted." If poured at this stage the ingot would be honeycombed with blowholes, due to the gassy condition of the metal. By raising the temperature and adding small quantities of silicospiegel or other substances which are either capable of combining with the gases, or of increasing the solvent action of the steel, sound ingots may be obtained.

In all the foregoing examples, it should be observed that crucible melting is implied. The fuel should not come in contact with the metals in making alloys, and better melting can be done in plumbago crucibles than in any other kind of vessels.

Furnaces are of different construction according to the different purposes to which they are to be applied. New furnaces for melting alloys are being designed thick and

fast, with the objects of increasing speed in melting and economizing loss of crucibles and metals. The claims of some recent oil and gas furnaces of the tilting pattern are great, but it will be some years before the old-fashioned pit furnaces, or the modern modification of it,—the caisson furnace is superceded, for the simple reason that forced draught furnaces are not well suited for melting alloys containing volatile metals.

Perhaps no class of alloys have suffered more from careless melting and wrong methods of combining the constituents than the white antifriction alloys. Antifriction alloys are based on the low co-efficients of friction and high atomic volumes of the components, compatible with certain degrees of fusibility, hardness and wearing qualities. Much depends on the physical structure and condition of these alloys for keeping down friction. They should be close-grained and thoroughly homogeneous. We know that many cheap brands of antifriction metals are made by melting antimonial lead and small quantities of tin together, and sometimes these compounds are dignified by the name of Babbitt metal! Also, it is customary in some quarters, to cast steam fittings from mixtures of scrap brass, scrap copper, and additions of lead or tin to bring them up or down to the standard of the firm making the goods. Scrap has its legitimate use in the making up of alloys but it is not always economical, nor good for building up a reputation.

There are other methods of preparing alloys than by fusing the metals in a crucible or other furnace, but as they have not reached to any extensive application in the arts, we can afford to pass them by. Nevertheless, there still remains many undeveloped theories relating to alloys, many phenomena of metals in conditions of contact, in solution and in solid combinations, to stimulate research and give rise to a better understanding of the science of combining the metallic elements.

The Severance-Broughton Co., of Walla Walla, Wash., has been incorporated with a capital of $25,000 to engage in a machine shop and foundry business. The incorporators are: A. W. Severance, M. H. Broughton and John McDonald.

MOLDING MACHINE PRACTICE.

BY F. W. HALL.

The successful foundrymen now using molding machines are those who have in their employ pattern mounters or molding machine men who understand the business from the blue print or the rough casting to the finished casting made from a molding machine. These men, if furnished with good, speedy machines, will mount the pattern in such a fashion as to give paying jobs even in the case of small orders.

A foundryman recently sent me a letter and blue print of a certain casting, and wished to know which type of molding machine was the one best suited to his special work. It seems he had communicated with several molding machine firms throughout the country concerning this casting, and each one claimed its machine was the one he needed. They also sent him several references, and after writing to these people he was in no better position to decide than before, as each machine was so vastly different from the others; and he desired to know the difference in a practical way. This I furnished, as well as some sketches showing it up.

Believing that others have been in the same predicament, and that still others may be in the future, I show in this month's article this special casting mounted on different types of machines, and I will endeavor to show the advantages and disadvantages of one as compared with the other.

Air-operated machines should be used. It is often said by the firms selling a hand-rammed machine that only the flat work can be successfully rammed by power, but I say from experience that the majority of work, yes, nine-tenths of it, can be rammed by power if looked into and tried. Sometimes a little tucking here and there will do the trick, and once you know where to tuck, only a moment of time is necessary to do it. An air-operated machine is at least 25 percent faster than a hand-operated machine, and the molds are more evenly rammed, thus turning out more uniform castings. It costs more to install an air-power machine than a hand-rammed machine, but after first cost everything is in favor of the power machine. As a general

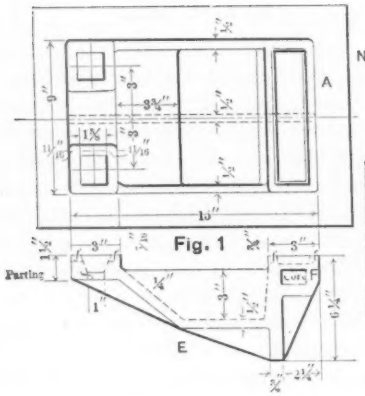


Fig. 1

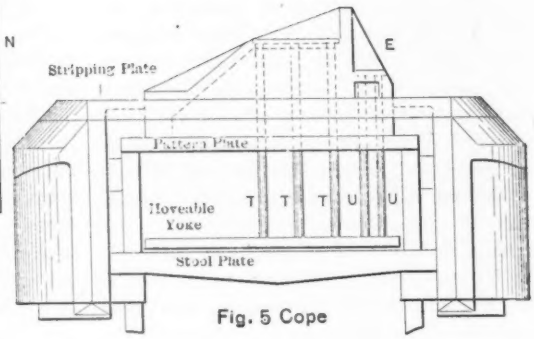


Fig. 5 Cope

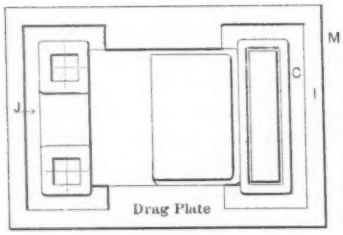


Fig. 2

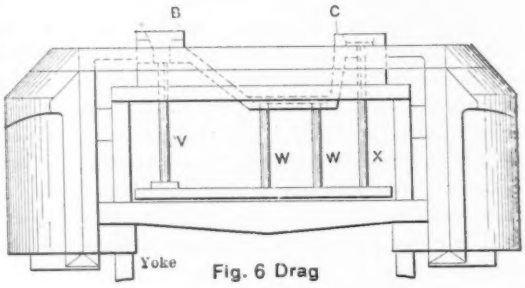
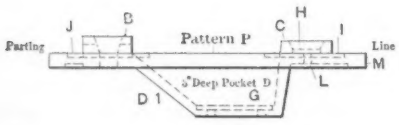


Fig. 6 Drag



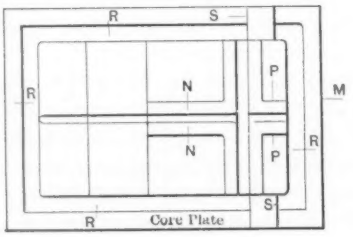
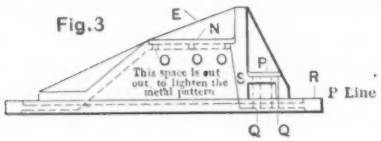


Fig. 3



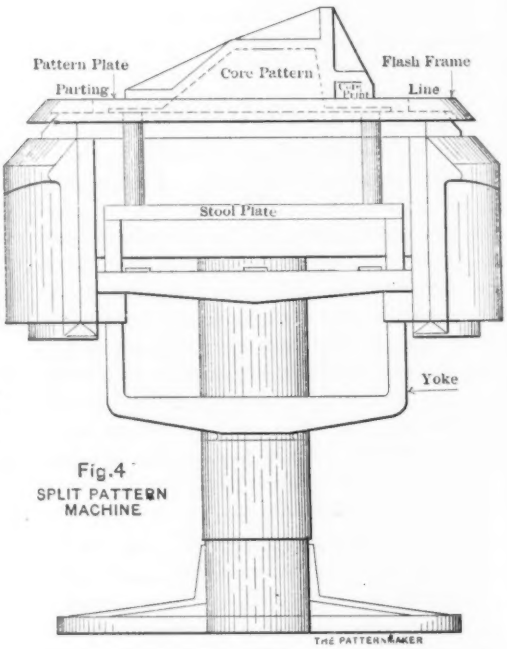


Fig. 4
SPLIT PATTERN MACHINE

thing, with mounting the patterns on a machine, nine-tenths of them can be mounted on a power split pattern machine far cheaper than on a hand stripping plate drop machine, so in a short time the first extra cost in installing the power machine will be made up in the saving gained in the mounting of the patterns.

To mount this special machine casting on a molding machine, proceed as follows: First determine where the parting line will be, and split the pattern on this line, making two distinct patterns, one for the cope and the other for the drag. In Fig. 1 this casting is shown in plan and side elevation, also showing where the parting line comes; the drag section of the pattern is shown in Fig. 2 mounted on a pattern plate, and the cope section is shown in Fig. 3 on a plate. In a great many instances it is advisable to make brand new master patterns, and from them to make iron patterns. A vertical miller is a very handy machine in pattern work, especially in molding machine patterns, but as this tool is not to be had in a great many foundry machine shops, I will substitute a planer and shaper to do what would be more conveniently done on a miller, and will construct the fitting of the patterns accordingly, laying out for the cope and the drag first on a split-pattern machine, and then on a drop pattern machine.

First take the cope, which is shown in plan and elevation in Fig. 3, and build up from the parting line; then make the pattern plate, M; the outside dimensions of this plate are made to fit the flask frame of the molding machine. The greatest thickness of the pattern plate is all around the edge, this being three-quarters of an inch thick when finished, while the interior of the plate is only one-half inch thick. The casting from this pattern plate is finished all over, save the under side of the half-inch section. On the top flat face of this pattern plate lay off center lines, and carefully locate the cope pattern true with the lines and scribe the outline of the cope pattern on the face of the plate; remove the pattern and cut out the interior of it, as shown in Fig. 3 in dotted lines. This is to reduce the weight so the pattern-rapping device can readily rap the pattern when in a mold; now set the pattern back on the pattern plate true with the previous scribed lines, and fasten it there. Then cut out the pattern plate under the pattern to match the shape of the cavity in the interior of the pattern.

Next remove the pattern from the plate, and add one-eighth of an inch material on the bottom edge of the pattern for finish (the remainder of the pattern only needs a file finish), while at points N, P, R, a pocket is cut in the pattern to the depth of one-quarter inch; the pocket runs all around the base of the pattern, while the point P is on both sides of the center stiffening rib, and the point N is similar to the point P. There is a core print in one end of the pattern which cores out a hole entirely through the castings. This is the only dry sand core in the job, so this completes the wood pattern work on the cope pattern plate and pattern.

The next step is the making of the wood pattern for the drag pattern plate and pattern; this takes in the remainder of the pattern shown in Fig. 1 and Fig. 2, so make another pattern plate similar in shape and size to plate M previously made for the cope pattern. Lay off on its upper face center lines, as was done on previous pattern plate, and from these lines lay off the location of the three-inch deep pocket designated by D, Fig. 2. Then build up the section DI, Fig. 2. The interior of this is the same as the interior of the pocket in the pattern (see Fig. 1); the thickness of the shell DI is about one-half inch, and in the bottom of it is a recess one-quarter inch deep, as in Fig. 2, and designated by G. The two holes K can be drilled in the casting. Now cut out the center of the pattern plate to match with the section DI, then fasten the section DI in its proper position on the under side of the pattern plate, and finish the cutting out of the pattern plate to make the three-inch deep pocket, as shown in Fig. 2. A one-eighth inch finish is allowed on the upper face of the pattern plate; this will make the depth of the pocket in the wood pattern three and one-eighth inches. Then make a wood pattern of the section, B, Fig. 2, and lay off from the center line on the plate its proper location; then tack the two sections B on just temporarily, then make a wood pattern of section C, Fig. 2, and tack it to the top of the pattern plate in its proper position. All around the three sides of section B, C (see Fig. 2), scribe a line

one inch away from B, C, in the plan view of Fig. 2 designated by J, I.

Cut this space out to the depth of three-eighths of an inch; this will make the finished casting of the pattern plate just one-quarter inch deep at this point; then in the interior of the section of pattern C, cut an opening entirely through it (see H, Fig. 2), then remove section B, C and give all the patterns a good coat of shellac and send them to the foundry for the desired castings. Have the necessary parts planed and drilled to fit the molding machine, then take the drag plate, Fig. 2, and proceed to fit it up as shown; get a piece of sheet brass one-quarter inch thick and dress out the recess G, J, I, to the thickness of the brass, then file up the sections B, C and fasten them on the plate M in their respective positions; then cut out of one-quarter inch sheet brass the strippers for the recess J, I, file and fit them into place till they rest level with the upper surface of the pattern plate. Also fit the outer shape of the patterns B, C. Then make another stripper for the recess G in the bottom of pocket D, like that in the recess J, I, and in the bottom of the recess G drill four half-inch holes through the shell D I, shown in Fig. 2, K. Do likewise in the recesses J, I, putting five half-inch holes in each stripper, then make the brass stripper for the pattern C, the pocket for which is designated by H. Carefully fit this stripper in its place and drill the necessary half-inch stool holes; proceed to locate the half-inch holes on the under side of the brass stools by means of a scribe up through the holes in the pattern plate. Drill the brass strippers for a bevel head screw, set them back into the recess made for them, and locate the screw holes on the ends of the stools. Next drill and tap the stools for the screws to be used. To determine the length of the stools, measure down through the half-inch holes in the pattern plate to the top surface of the stool plate; make these stools out of half-inch cold-rolled steel; this finishes the drag plate.

Proceed to fit up the cope plate as follows: Have the cope pattern E set in the shaper and finished to the proper measurement, remove the pattern from the shaper and dress up the outside of the pattern with a file. Have the plate M, Fig. 3, finished to fit the machine, as was done with the drag plate, then on the upper face of the pattern plate lay off the true location of the pattern E just finished, taking care to have this location perfectly true with the pocket in the drag pattern plate. Scribe the outline of the pattern on the plate, mark the plate and the pattern so the pattern can be moved and set back at any time; then in each corner of the pattern location on the plate, drill a hole for a machine screw. Set the pattern back on the plate again and scribe the location of the four holes on the corners of the pattern. Drill and tap the pattern at this point for the screws to be used.

This pattern, if properly finished up, will clear from the sand without any strippers at the base of it, but if a stripper is wanted at its base, then a recess should be cut in the plate M and a stripper set in, as shown in the drawings (See Fig. 3, R), so proceed to dress out the recess, N, P, R in the plan view of the same depth as was done in the previous plates. File and fit in the necessary strippers in a similar way, having their surfaces flush with the level of the pattern or the plate. Determine the length of the stools, cut them off from a bar of cold-rolled steel, drill and tap them, and also the brass strippers for the screws to be used, Q, Q; mark the holes where the stools go through the pattern. Now locate the core print S, Fig. 3, on the plate, as shown in Fig. 3. This print runs out to the edge of the pattern plate for the purpose of venting the mold; it can be made of hard wood and plenty of draft should be left on its sides and end, as no stripper is to strip it.

This completes the description of the pattern mounted on a split-pattern machine. The split-pattern machine is shown in Fig. 4, showing the cope pattern mounted on it, and when in operation the yoke, the stool plate, and the flask frame go up while the pattern plate remains stationary.

I will now show the same pattern or job mounted on a drop pattern machine, as in Figs. 5 and 6. This will make a slight change in the patterns, which I will describe without any more drawings. Fig. 5 is the cope machine with the cope patterns mounted on it, E represents the pattern; T, U, represents the stools resting on the stool plate. These stools pass through the pattern plate, a clearance hole being drilled

in the pattern plate for that purpose. The stripping plate is made in the usual way, thick all around the outer edges, and one-half inch thick in the middle; the center being cut to the shape of the pattern and acting as a stripper to the outer outline of the pattern. On each end of this stripping plate are the ears for the flask pins, the pattern plate is resting on the top of the movable yoke, while on top of the pattern plate is the pattern E; the parting of the pattern comes on a line with the top surface of the stripping plate.

At this point the pattern changes from the previous method, as the pattern E in this method rests on the pattern plate below the parting line, while in the previous method it rested on the pattern plate, which comes flush with the parting line. In Fig. 5, the parting line of the pattern and the top of the pattern plate are one and one-half inches apart, so this space has to be made up. It is sometimes made up on the pattern and sometimes on the pattern plate, where the cope and drag patterns have to be pinned together and made to match one another by finishing them in that position. Then the pattern should be split as near to the parting line as possible, but in this case the patterns are not finished up while clamped together, and so the space between the pattern plate and the parting line is made up by adding to the under side of the pattern. The center of the pattern is cut out for lightness, the points to be stooled are the same as in the previous method, and the stools are designated by T, U; iron or wood flask can be used for this job, as in the previous method. To fit up the plates and the pattern for this machine, as shown in Fig. 5, proceed as in the previous method, first finishing up the pattern, then set it on the top of the stripping plate in the desired position, and scribe the outline of it on the stripping plate. Remove the pattern and dress out the stripping plate to this scribed line, taking care to have a nice fit with the pattern, then drop the pattern down through the opening in the stripping plate, and rest on the pattern plate below, which has a finished surface. Then scribe the outline of the pattern on the pattern plate, and within this scribed line, and in the center of the area of the pattern plate that is covered by the solid part of the under side of the pattern, drill four holes entirely through the pattern plate, then with the pattern sitting in its place, locate the holes on the under side of the pattern E. Drill and tap the pattern at this point for the screws to be used, then fasten the pattern down, put in the stools, and you have it complete save the drilling of the plate to fit the machine.

Now for the drag pattern shown in Fig. 6. The parting line here is the same as in the previous one, as the top surface of the stripping plate represents the parting line of the flask, as well as for part of the pattern B, C; the remainder of the parting line protrudes down into the machine, so far down as to hit the pattern plate, if it were not cut out. After making the drag pattern to the desired shape, as shown in Fig. 6, set the pattern B, C in the opening of the stripping plate, the parting line coming on a line with the stripping plate, then under the four corners of the pattern add the square feet that will make up the distance between the plates. These square feet are cast on the pattern, and a finish is allowed on them, then while the pattern is setting through the stripping plate and resting on the pattern plate, mark the location of the four feet of the pattern on the top of the pattern plate, and have the pattern plate all cut out between these points. This is all done on the wood pattern; when the iron pattern is fitted through the stripping plate and resting on the pattern plate, drill a hole through the pattern plate and into the feet of the pattern; tap out the hole in the pattern and fasten the pattern to the pattern plate, as was done with the cope pattern.

These stools, V, for the two square holes to be stripped in the end of the pattern, are fastened to the stool plate to prevent the stools from turning around after the pattern is drawn through the stripping plate. The four stools in the center of the deep pocket D are shown at W, while X represents the stools that strip the long pocket in the other end of the pattern; X, like W, merely rests on the stool plate.

This completes the mounting of the pattern on this type of machine. In making a mold of this pattern and this special job, a soldier or two will have to be used to hold the sand in the deep pocket to the remainder of the mold.—[*The Patternmaker.*

REVIEWS.

TOP OR BOTTOM POUR.

Stahl und Eisen, No. 8, 1905. A. Messerschmitt goes into this subject pretty thoroughly, giving a great number of examples. We take only the general deductions in the following: In discussing the strength of a casting, its oxidized surfaces and interior shrinkages, the argument used is that the lower portion of a casting is always denser and sounder than the upper, on account of the pressure exerted by the column of melted iron. From this it would be supposed that the lower portion of a casting has metal of a higher tensile strength than the upper. Experience has demonstrated that this is not always the case. Where, for instance, a bar is cast vertically with a top pour, the length being about 20 inches, the strength of the casting will be found perfectly uniform. When, however, the bar is cast with a bottom pour, the lower portion will be found considerably stronger than the upper; or rather, the lower portion of the bar is as strong as the whole bar would have been had it been cast with a top pour, and the upper portion will be weaker. In cases where much machining is to be done on castings, this difference in strength due to the manner of casting disappears in a great measure.

A series of bars was cast both ways in order to learn something of the behavior of cast iron under both conditions when compared together. It was easily seen that the lower part of the mold, in the case of bottom pouring, would be kept full of hot metal longest, and hence all lighter particles, such as graphite, slag, etc., would rise to the top. In fact, even liquid parts of the metal would segregate out and go upward. The upper portion would therefore be less dense. The behavior of sulphur is interesting in this connection. In the larger bars, where the metal remained fluid some time, the sulphur rose upward, there being a difference of from 0.02 to 0.36 observable, the sulphur content of the iron being 0.12. With lighter bars, the iron set quicker and but 0.04 to 0.05 was the difference in sulphur between top and bottom of the bars, where bottom pour was used, and no difference with top pour.

Where one is not certain of the quality of the pig iron used in a mixture the method of top pour is always to be recommended for general casting work. In making a bottom pour it will be noticed that as the metal rises the skin forming becomes thicker and more pronounced, is broken repeatedly by the rising iron, and contains all the impurities floating on top. Wherever a projection happens in the mold, this skin and dirt lodges and is sure to leave a bad spot in the casting. In the case of very thin sections, this trouble may condemn the casting entirely.

Even where the irons are well known, it is advisable to use the top pour in castings of a complicated nature, for the skin of oxide, and dirt formed, even with castings of a depth of only 16 to 20 inches, is a serious matter. With the top pour, the skin on the iron is continually broken up, and many of the difficulties are avoided. However, it must be admitted that the bottom pour has many advantages. The molds can be made cheaper, as the metal is quiet during pour, and no strains other than the ordinary are put on the mold, unlike the top pour. Less precautions to avoid cutting may be taken, and one does not like to give up these advantages. Hence it may pay to arrange matters so that a bottom pour is used for the first iron sent in, and then complete with the top pour when the iron has reached a certain height. In this way the presence of much dirt in the cope side of the casting is avoided, a matter especially pronounced with high silicon irons where graphite is apt to separate out readily. In arranging the molds, plenty of risers must be provided to take care of the dirt, oxide and slag separated out.

THE BEHAVIOR OF THE SULPHUR IN COKE IN THE BLAST FURNACE.

Stahl und Eisen, No. 12, 1905. Prof. Wuest and P. Wolff recently made some experiments to learn if possible just what the effect of the sulphur in the coke used for blast furnace purposes had upon the iron made. As this interests the foundry in so far as comparisons can be made with the cupola melting process, the general conclusions are given herewith. The experiments themselves were made very carefully and continuously on the blast furnace gases in different positions of the stack; the sulphur was determined in this as well as the ores, coke, limestone, and the slags made. Thus a balance of the sulphur going in, and that coming out could be established, and the

location of every portion of it accounted for.

The results came out fairly successful, and showed that sulphur in coke is driven off to a considerable extent before the melting zone is reached. The lower temperatures find the sulphur absorbed by the iron oxide, and even the reduced iron. The higher temperatures cause the sulphur to combine with the lime of the charge. The dividing line seems to be 1,475 degrees F. Above this the lime begins to act as a desulphurizer. Below this point, some of the sulphur tends to go into the iron. Hence the advisability of running the furnace hot.

Applying this information to the cupola, we have our experience borne out in the above. Cold heats always have more sulphur than hot ones. Hence in the foundry also it pays to use plenty of coke, not only to get good hot iron, but to keep down the sulphur.

CASTING NON-FERROUS METALS.

Eisen-Zeitung. No. 11. The casting of metals other than iron requires greater precautions than are usually necessary in the iron foundry, on account of the greater effect the melting process has on their properties. Thus, oxidation makes such metals as lead, zinc, tin, aluminum and copper, as well as their bronzes, porous and brittle, these defects being specially noticeable when in the form of castings.

The molds used, while preferably of sand on account of greater cheapness, must nevertheless be made of iron finely finished, for sand leaves a very rough surface, especially for art work. In casting bronzes into these iron molds, there is danger of burning on the metal, and hence the following process is recommended to avoid this disagreeable difficulty.

Take the tin to go into the bronze, and add 1½ percent of metallic sodium, the two metals being heated up separately. The tin, after being melted, is poured into the sodium, which has been previously heated up to 200 degrees F., and as free from contact with the air as possible. The alloy thus formed when cold, is broken up and put away for use. The tin must not be allowed to get hotter than 435 degrees F., otherwise the sodium would catch fire, and the result be worthless. The copper intended for the bronze is now heated up to say 1,300 up to 1,475 degrees F., or a little lower than its melting point, and the tin-sodium alloy added. If the latter alloy be added to melted copper, the sodium would evaporate out immediately, and this is to be avoided. Hence, the copper is kept below the melting point, and as soon as the alloy of tin and sodium is added, an amalgamation takes place, and the sodium is acted upon gradually. The affinity of sodium for oxygen is so great that the reaction raises the temperature of the mixture up to 2,000 to 2,200 degrees F., and the bronze formed can be cast into the molds at once, the residue of the sodium remaining in the melt burning out during the pour, and the white fumes coating the mold. This coating prevents the sticking of the metal. Castings with a perfect skin are the result, and require no subsequent treatment to improve their appearance.

Another method recommended in this connection, is to use metal molds which are lined with a special composition which can be easily replaced. In this way the early destruction of expensive metal molds is averted, and furthermore, the lining may be so selected that the chilling effect on the castings is considerably reduced. The lining must be made of alloys having the same contraction as the metal to be poured, but with a higher melting point, to prevent burning together. Thus—if the castings are to be of 60 percent copper and 40 percent tin, the lining of the mold must be about 65 percent copper and 35 percent tin. Or where the metal to be cast is 71 percent copper and 29 percent zinc, the lining should be 75 percent copper and 25 percent zinc.

For casting brass and tombac, the lining of the iron molds can be made of the same materials as the castings, plus 7 percent aluminum. In special cases a further addition of 0.1 percent chromium is advisable. Where aluminum is to be cast, the lining may be aluminum bronze with a high aluminum content. The thickness of the lining will depend upon the weight of the castings to be made, and can be attached to the iron mold in any convenient way which will not show on the skin of the castings.

In melting the precious metals, it is important to exclude the air as much as possible to avoid undue absorption of oxygen. A refractory mold is made to consist of two

chambers. The upper is practically a crucible for the lumps of metal, and the lower chamber is the mold to be filled. A vent leads from the upper to the lower chamber, so that the melted metal can drop down and fill the mold. The refractory mold is now placed in a crucible large enough to hold it. Quartz wetted with tar or mixed with a little coal is rammed tightly around the mold to make the whole solid. Melting now proceeds. The heating up of the quartz means expansion, which serves to hold the mold tight. The metal in melting and trickling down can now fill the mold perfectly without being in contact with air. The melting is done in a muffle or air furnace, and the crucible containing the mold is brought up to a temperature 100 degrees F. higher than the metal to be melted.

Where ingots of copper or brass are to be cast, and these are intended for subsequent rolling or drawing to wire, there is danger of a peculiar kind of chilling which results in the splitting of the sheet or wire made. This is because the ingot is cast into chills, and this means a crystallization next the chills and neutral metal in the center. The tearing apart when rolling is always at this center. To avoid this it has been recommended that one side only of the ingot mold be made of iron to touch the metal, and the other face be arranged to receive a coating of loam or sand. The best results are obtained if the chill side is also coated with oil before casting. Now instead of getting an ingot with the crystals radiating from the sides inward uniformly, as in the old way, this process is broken up, and the structure of the metal is different from one side through to the other. These ingots will not split in rolling.

In casting phosphor-aluminum alloys, there is a great tendency on the part of the castings to crack, especially when cast into sand molds. These castings, moreover, are seldom free from scabs. To overcome this difficulty, metal molds should be used, and these heated up red hot before pouring. The castings are taken out quickly, and cooled in the air.

Where magnesium-aluminum alloys (magnalium) are to be cast, the special difficulty experienced is sponginess in the interior. It is necessary to cool rapidly to avoid this, and as ingot molds are too costly for this class of work, sand molds filled with metal rods and plates may be used. This metal draws off the heat quickly, and gives no time for the magnesium to burn out of the alloy.

LOCHNER'S SYSTEM OF DRYING MOLDS AND CORES.

Stahl und Eisen, No. 2. 1905. This interesting method makes use of the heat remaining in castings which have just set and are stripped from their molds. A pit is sunk into the ground, or else an oven erected, and so arranged that an upper chamber is provided, into which the castings still red hot, or even white hot, are placed. Below this, and separated from it by perforated plates, is the lower and smaller air chamber, which allows cold air to pass upward well distributed, the air coming into it through a suitable flue with a damper at the end.

While molds are placed on the cover of the upper chamber, cores may be placed within. Stoppers are provided in the cover to allow the superheated steam from the cores to escape, the air flue being closed while the cores are baked. Further suitable openings in the cover allow the hot air generated when the damper is raised to pass upward through the molds to be dried. This arrangement makes two distinct processes. The first, for core baking, where the air circulation is cut off, and the escaping steam has a temperature of some 475 degrees F.; and the second process of regular mold drying with a splendid circulation of hot air through them.

The advantages of this system are manifold. No core or drying oven fuel is necessary at all. The handling of material is the same whether this arrangement or the usual drying ovens are used. Furthermore, the sand from which the hot castings have been removed cools much quicker, with beneficial results in summer to the men.

The method at present is used for drying ingot molds, the molds thus made showing much longer life in the steel works than was the case before drying the ordinary way was carried on. Tunnel segments also when made thus were relieved of the strains they ordinarily have without drying the molds. It is claimed that this method, when used for heavy work, saves 75 cents a ton in fuel and other expenses, over the ordinary way.

LINING STEEL VESSELS WITH CAST IRON.

Eisen-Zeitung, Aug. 31.—It is often necessary to perform operations, in chemical works, in cast iron vessels while under heavy pressure and high heat. It has been customary to forge a wrought iron shell

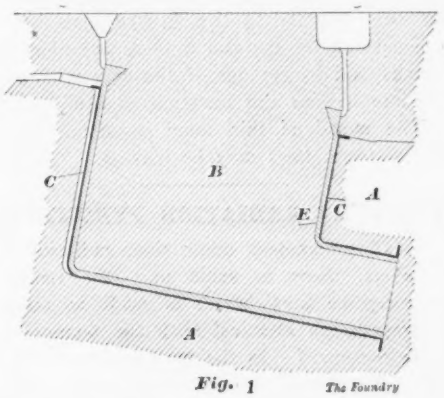


Fig. 1 The Foundry

around such castings, but always with poor results, as the contact leaves much to be desired. Of late the use of steel shells lined with cast iron has come into use, and where proper precautions are taken every purpose is answered.

Ordinarily simply bedding the shell in molding sand, and hanging the core into it, gives disastrous results, for the shell ex-

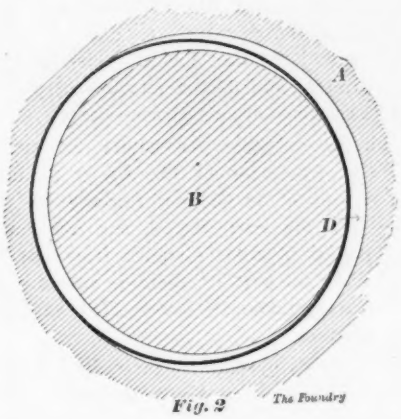


Fig. 2 The Foundry

panding ruins the mold, and furthermore leaves the lining of eccentric cross section. To overcome these difficulties, the following method has been devised:

Fig. 1 shows the mold A with the core B. The steel shell C is so placed, Fig. 2 D, that it touches the mold at one side only, space being left for the shell to expand in it and fill it out completely. The core B is now so placed that it is in its proper position opposite to the point of contact of the shell and mold. When the iron fills the space E between core and shell, and the latter expands, the result will be a casting of uniform thickness. The method is said to give excellent results.

ANOTHER LOADED CUPOLA.

BY HARRY MALONE.

In a recent number of *The Foundry*, I saw an article by John Doyle, describing an accident that occurred to a Southern colonel (I presume he was a colonel as any one of importance in the South usually is), who found out what a cupola would do when fed loaded shells.

This experience reminds me of a similar experience which occurred a few years later than the one related in that article. This happened in a small foundry located in a mining region where castings were made for mining car wheels, pump repairs, and in fact, any old thing that came along. The scrap heap also contained every old thing that came along, and it was the duty of the melter to break up the larger and heavier pieces of scrap. Being of an experimental turn of mind, and finding that his cupola was a hungry rascal, he kept rolling in bigger and bigger pieces until he would finally charge any chunk that he could roll into a charging door.

One time there was a piston head about 20 in. in diameter and 4-in. face brought in. The piston was of rather peculiar construction, for it had a ½-in. steel band shrunk about the center and follower rings on each side to hold the packing rings against the aforesaid steel band. It was also pretty well ribbed on the inside so that it was very strong. The melter hit it a good many times with the sledge, and being naturally a tired man, he decided it would be easier to roll it into the cupola, figuring that it was a perfectly innocent piece of cast iron, and if he put it in edgewise, it certainly would not do any hurt. Consequently the next day he charged his cupola up to the charging door, and when he put on the last charge of coke rolled the piston onto it and left it standing there on edge.

When he looked into the furnace again a

few minutes afterward the piston had fallen down and was lying on its side. This did not worry him much, and he put in the balance of the charge. The first iron came down hot and was used all right, but the iron suddenly ceased to flow, even though the blower was working as fast as it could. As a consequence the tap hole was stopped and most of the boys went way back to the other end of the foundry and sat down while the melter busied himself at one side of the cupola.

Suddenly something inside of that cupola went off, taking with it two sections of the shell and throwing bricks through the other end of the building 120 ft. away. The portion of the wall adjoining the cupola was literally blown to slivers, and all of the charge above the place where the explosion occurred blown out of the furnace, some of it going up through the chimney and falling on the foundry roof.

As in John Doyle's story, the melter escaped unhurt, except that he was very badly burned by the hot coke which fell on him. Not another soul in the foundry was hurt, though it is a miracle how all the bricks found their way through the building without hurting anybody.

Most of the molds in the vicinity of the cupola which had not yet been poured were pretty badly broken up by the shower of bricks, coke and scrap iron, and the portion of the cupola shell which was blown out was straightened out almost perfectly flat.

After quiet was restored in the foundry and the debris cleared up, there was much discussion as to what caused the explosion. Most of the men were of the opinion that that piston lying flat in the furnace caused an accumulation of gas which exploded, but if this had been the cause the piston would not have been broken, but would simply have been blown up the stack. As it was, the piston was burst like a bombshell, and the ½-in. steel band shrunk around the outside was blown almost inside out—that is, it was blown straight and then bent the other way until it formed a semi-circle with the surface which formerly had been the outside on the inside.

The writer expresses his opinion that during the life of the piston steam had found its way through some porous spot in the metal and condensed on the inside, and that in this way a quart or so of water had accumulated in the piston, later the porous spot had become so rusted that more water could not pass either in or out. When the piston became hot in the cupola the water was converted into steam and superheated until it may have had a pressure of at least 800 lb. to the square inch before the casting let go, and it is no wonder that things had to get out of the way with such a force behind the bursting piston.

The moral of this story is—smash up all old pistons; they may be loaded.

THE FÉRY RADIATION PYROMETER.

In all pyrometers other than radiation pyrometers, there is some part—the sensitive or receptive part—which is made to acquire a temperature identical with the temperature to be measured. In the measurement of furnace temperatures, for example, radiation pyrometers are the only pyrometers which are entirely outside the furnace. As is well known, it is difficult to construct anything of solid material which can be maintained for prolonged periods at a high temperature without suffering some permanent or sub-permanent change in its physical properties, and as we ascend higher in the temperature scale, the difficulties increase in a quite disproportionate degree.

A further aggravation of the trouble is to be found in the chemical activities of furnace products and furnace gases, which in some cases render difficult the adequate protection of a resistance-wire or thermo-couple.

With the radiation pyrometers, invented by M. Féry, Professor of Physics at the École de Physique et de Chimie, Paris, these difficulties are not encountered, the instruments being placed at some distance from the furnace, while no part of them is raised above the air temperature by more than 80 Centigrade degrees.

In M. Féry's pyrometers the radiation which emanates from a hot body, or which passes out through an observation hole in the wall of a furnace, falls upon a concave mirror or upon a system of lenses as the case may be, and is thus brought to a focus. In this focus is a thermo-electric couple, whose temperature is raised by the radiation falling upon it: the hotter the furnace, the greater being the rise of temperature of the couple.

The arrangement of the instruments is such

that they are uninfluenced, within wide limits, by the size of the hot body or observation hole on the one hand, or on the other hand by the distance which separates them from the hot body or furnace.

The absorption of some small amount of radiant heat in passing through the atmosphere cannot, of course, be strictly without effect; but in practice the error thus arising is not appreciable; it has been found, for example, that the reading obtained for the temperature of a stream of molten steel was precisely the same—1,200° C—whether the instrument was set up 3 ft. or 60 ft. away.

A complete instrument consists of telescope and galvanometer, fixed within the telescope.

FIG. 1.—PYROMETER IN USE.

At a point upon its optic axis, is the junction of a copper-constantan thermo-couple, arranged in the form of a cross. The two wires are attached to two brass strips D and R, which are attached to the terminals bb′, Fig. 2. The terminals are connected by leads to the galvanometer, as shown in Fig. 1. To use this apparatus for measuring the temperature of a furnace, an observation hole in the wall of the furnace is sighted through the eye-piece O, the image of this hole being brought into coincidence with the thermo-junction. It is essential that the image of the observation hole should slightly overlap the junction, which appears to the eye as a black disc in the centre of the field of view. The readings of the instrument are then independent of the size of the observation hole.

In the mirror instrument, the image of the hole is reflected to the eye-piece O by two

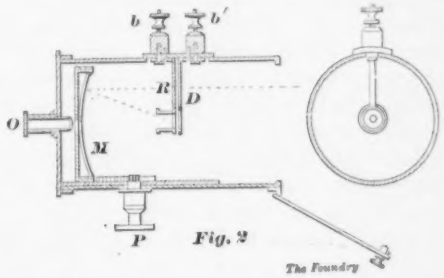


Fig. 2

The Foundry

small plane mirrors placed close to the couple. These mirrors serve for the adjustment of focus; they are so arranged that the image of the hole appears to be split into two parts, which only blend together to form an unbroken image when the focusing is correct. Fig. 3 illustrates the changes in the appearance of the field as the focus is altered.

The image thus formed upon the junction produces a rise of temperature which is shown experimentally to be proportional to the amount of radiant energy which enters the telescope. The junction acquires exactly, and with great rapidity, the temperature of the image, but in no case does its temperature rise by more than 80 Centigrade degrees above the atmospheric temperature. The electro-motive force which is thus generated is measured by a highly sensitive galvanometer whose scale is divided and figured so as to read temperatures directly.

This galvanometer, notwithstanding its sensitiveness, is of substantial construction; it comprises a finely-pivoted moving coil,

Fig. 3

The Foundry

provided with a long pointer. The movement of the coil takes places within a single air-gap between the poles of a strong permanent magnet. These galvanometers are invariable in their indications, and unaffected by all ex-

ternal influences. They are self-leveling, so that no adjustment of level is required before a reading is taken. By turning a milled head the moving coil can be freed when a reading is to be taken, or clamped to facilitate the removal of the instrument. Another milled head enables the divided scale to be unclamped, adjusted in position to a small extent, and reclamped, so that the reading is zero when no current is flowing. The galvanometer has a resistance of about 10 ohms, and is connected by leads about 30 ft. long to the terminals of the pyrometric telescope.

The graduation of the galvanometer scale is based upon Stefan's law, which expresses the relation between the temperature of a body and the amount of radiant energy which it emits. The law is as follows: "The radiant

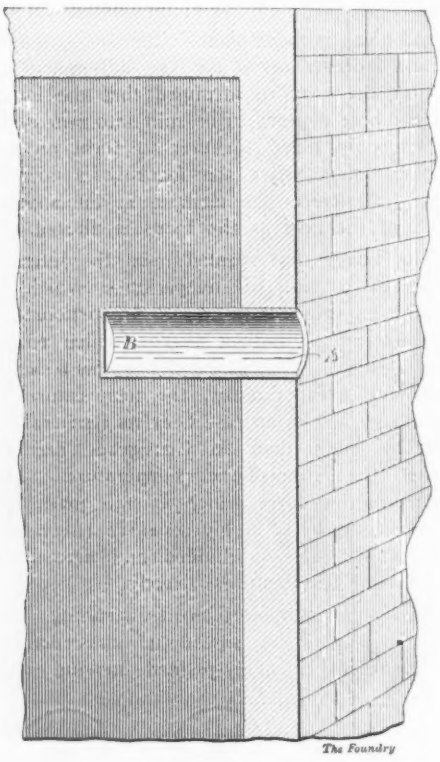


Fig. 4

energy emitted by a perfectly black body is proportional to the fourth power of the absolute temperature of the body." This law is a mathematical deduction from the electromagnetic theory of light.

Though no radiating surface is truly black in the theoretical sense, iron and steel exposed to the air at or above a red heat fulfil this condition very closely, and the same is true of copper, but there is also a much larger class of effectively black bodies.

If the inner wall of an enclosure E, Fig. 4, is at one temperature throughout, and if an aperture A through which radiant heat emerges is of small dimensions compared with the depth of the enclosure behind the aperture, then the radiation proceeding from the surface B of the enclosure will be independent of the character of the surface, and the same as if the surface B were perfectly black.

The arrangement sketched in Fig. 4 is one which is actually used in taking furnace temperatures by means of the Féry pyrometer.

Moreover, in many industrial processes, a knowledge of actual temperatures—Centigrade or Fahrenheit—is not essential, provided some standard is available which serves to distinguish between higher and lower temperatures, and enables correct heat regulations, obtained, to be reproduced with certainty. Suppose, for example, that we are sighting the pyrometer on the metal in a crucible, and that the reading obtained on the temperature scale of the galvanometer is 1,100° C. Owing to the surface of the metal not being absolutely black this reading may be lower than the true temperature, which we will suppose is 1,180° C. If we find that the castings obtained by pouring the metal under these heat conditions are satisfactory, and better than those resulting from pouring either hotter or colder metal, we shall have reached the important practical conclusion that the correct pouring temperature for the metal in question produces a reading of 1,100° C on the temperature-scale of the galvanometer—even though we do not know the true temperature of the metal on the Centigrade scale.

Since the energy radiated from a hot body increases very rapidly as the temperature is raised, it follows that the Féry pyrometer is far more sensitive at high than at low temperatures. Temperatures as low as 600° C. can be read, but the instrument is most useful for high temperature work. As examples of high temperature measurements made with the Féry pyrometer, mention may be made of the temperature of the sun (7,800° C.) determined by Professor Féry, as well as the temperature of the iron in a thermit mold, which was found to be 2,500° C. The instrument is thus of especial value for taking such high temperatures as those of molten steel of gas settings, of glass furnaces, brick kilns

and electric furnaces. Its great flexibility, and the readiness with which it is sighted, enable it to be used for taking the temperature of metal in a crucible just before pouring, thus insuring correct casting temperatures, a point which is now known to be of especial importance in the case of steel castings. Forgings, billets, blooms, and finished rolled sections are also readily followed through the various operations which have to be performed on them, great progress having already been made in this direction.

A point which may need further explanation is the arrangement that insures that, within limits, the readings of temperature shall be independent of distance.

Suppose that we are sighting the telescope upon a hot body of limited dimensions. The total amount of radiation reaching the aperture of the lens or mirror will vary with the distance from the hot body, and will be inversely proportional to the square of the distance. If, then, the receptive surface of the thermo-junction were sufficiently extended to receive the whole of the radiation, which is converged to a focus by the lens or mirror, we might expect the indications of the galvanometer to fall off as the distance was increased. The thermo-junction, however, is not large enough to receive the whole of the radiation which converges towards it. The real image of the source, formed by the lens or mirror, overlaps the thermo-junction on all sides, (Fig. 5a) so that when we approach the source more nearly, thus increasing the size of the image produced, the only effect is to increase the amount of overlapping, while the thermo-junction receives no more radiation than before (Fig. 5b). On the other hand, if we withdraw to so great a distance that the image formed is too small to cover the thermo-junction completely (Fig. 5c), the readings obtained will be too low, and will become lower and lower as we recede further and further from the source of heat.

From the above it will also be readily understood that when we are working at any given distance from the hot body, it is necessary for the body in question to be of sufficient size; otherwise the image of the body would be too small to overlap the thermo-junction on all sides. But provided the hot body is large enough to secure the necessary overlapping, no further increase in its dimensions will add to the amount of radiation actually received by the thermo-junction. The diameter of the hot-body (or furnace aperture) should measure as many inches as the distance from hot-body to pyrometer measures yards.

A similar galvanometer is also made and calibrated so as to measure directly low temperatures, the temperature of liquefaction of gases, liquid air and liquid carbonic acid, or for the measurement of moderate tempera-

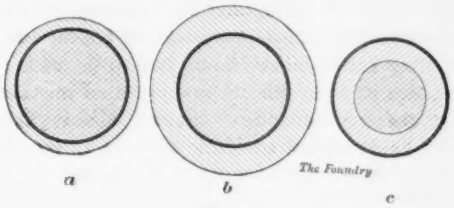


Fig. 5

tures between 0° and 600°C. In such cases the galvanometer is connected by leads to a copper-constantan thermo-couple immersed in the medium whose temperature is required. The couple is enclosed in a tube which leaves the junction exposed. These couples should never be heated above 700°C.

The sole agents for the sale of this instrument in America, Great Britain and her colonies, Norway and Sweden, are the Cambridge Scientific Instrument Co., Cambridge, England.

MAKING MISTAKES.

BY DR. EDWARD KIRK.

At the time of my first visit to Shamokin, Pa., a small town in the anthracite coal fields, there were two small foundries in the town. One of these was the foundry of John Mullholland, which had been in operation for some time and had an established business. The other one had been recently built and put in operation by a young man who appeared to be a thoroughly practical man, and the plant had every prospect of being a success. On my second visit to the town some five years later, I found the Mullholland plant in operation very much enlarged and doing a good business.

After transacting my business with Mr. Mullholland I inquired if the other foundry was running, and was informed that it had gone out of business. Upon further inquiry I learned that the young man had not made a success of the business and Mr. Mullholland had purchased part of his material and after-

wards employed him as superintendent of his plant. Upon inquiring if he was still in his employ, for I had been favorably impressed by the young man, and desired to see him. Mr. Mullholland informed that he was not, and that he had proved a very valuable man to him for a short time, but one day he came into the office and reported that in turning up a piece of iron a machinist had made a mistake, and the iron had to be thrown to one side. A few days later he reported another machinist had made a mistake in boring out a casting and another casting had to be made to replace it, after this the complaint of mistakes by the superintendent became almost daily and he deemed it advisable to make an investigation, as to why so many mistakes were being made.

Upon inquiry he found that his new superintendent had quarreled with almost every man in the shop. That some of the mistakes were the fault of the superintendent. Others had been exaggerated and his entire working force was in an uproar, and to settle matters, he was compelled to let his new superintendent go.

Mr. Mullholland then informed me that he had not found it advisable to investigate the mistakes made by workmen, and that he had at various times in passing through his machine shop found pieces of work upon which a machinist had worked for from a few hours to several days, thrown aside from some mistake that had been made and that he had not attempted to place the responsibility for the mistake or spoken to the workmen about it; and in the foundry he had seen numerous bad castings without making any inquiry about them. Now this will no doubt appear to many of the readers of *The Foundry* as an extreme case of "rule o'thumb" business management, but as is well known to every founder in this district, no one man in the anthracite coal fields made a greater success of the foundry business than John Mullholland. While the young man who was continually looking for and criticising the mistakes made by others, made the greatest mistake himself and not only lost his foundry plant but also a good position, and would probably in a short time have caused Mr. Mullholland to have lost his plant had he not let him go.

Mr. Mullholland's system was to employ a competent foreman in each department of his plant and depend upon him to select good workmen. If the foreman found the workman incompetent, he was at once discharged and only good workmen retained. If these men made a mistake occasionally that condemned a piece of work, it was quietly put to one side or broken up and nothing said about it to the workman. This system gave the workman no opportunity to explain or make excuses to his employer, and made him feel more keenly his mistake than would have been the case had he been called upon to explain why he made the mistake, or upbraided for it before his fellow workmen. Had this been done he might have attempted, either justly or unjustly, to have shifted the blame to the foreman or some fellow workman, which would have caused an ill feeling between them and in which other workmen would have taken sides and caused no end of ill feeling in the shop, which sooner or later must result in loss to their employer. For that spirit which prompted us when boys going to school to get even with the boy who hit us in the ear with a snowball or played a mean trick upon us, and if we could not get even with him do something to his little brother, or chum, still exists to a greater or less extent in the man, and manifests itself when he thinks he has not been fairly treated.

When a man is called to account for a casting he has lost, or a piece of work he has spoiled, and is lectured or paraded for it before his fellow workmen, this spirit is aroused. He frequently thinks he was not wholly responsible for the mistake made or that it would not have been known had not some fellow workman told of it, and he watches his chance to get even with the man he blames for the mistake, or the tattler, who is usually accused of telling tales to curry favor with his foreman or employer, or with his employer, whom he thinks had no business to upbraid him before his fellow workmen for a trifling mistake. He may secretly cause the man whom he blames for his mistake to make a mistake that will condemn his work. He may arraign many men in the shop against the man whom he accuses of being a tattler, and cause ill feeling and more mistakes to be made, or he may cause a piece of work he has spoiled to be put into a machine that will condemn the entire machine to get even with his employer. In either case the employer is the loser and all because he did not know how to handle a mistake made by a workman.

The handling of workmen in a large plant is a science, and as great a science as the handling of an army. No general can hope for victory who goes into battle with a discontented and disorganized army, and no employer can hope for success who attempts to carry on his business with discontented and disorganized workmen.

A manufacturing plant, be it large or small, should be managed on business principles. There should be regular hours for work, a stated time for going to work and quitting. There should be a regular pay day, at which every man receives every cent due him, less a week's pay kept back should this rule be adopted.

Pay day should be once a week, for few workmen care to wait more than a week for their pay. Rules should be printed and hung up in the shop for the regulation or guidance of the workmen, that they may know what is expected of them, and these rules should not be arbitrary and all one-sided, as is frequently the case. The man who makes these rules should try them upon himself as a workman, to see if they are just before having them adopted for the shop. The rule of docking a man one hour's time if he is five or ten minutes late is a poor one, for the man usually loafs about the shop talking to other workmen and causes his employer several times the loss he would have sustained by the loss of five or ten minutes' time.

If he is kept out of the shop for this hour, he may go home and the profits on his day's work be lost. A better plan is not to notice it if a man is unavoidably a few minutes late occasionally, and if he makes a practice of being late, advise him to seek employment at a plant where they begin work at a later hour. If a mistake is made it should be passed over with as little said about it as possible, and if these mistakes become too frequent the workman should be allowed to seek work he is competent of doing.

No tattling or carrying of tales to the foreman should be allowed, for if permitted, there will in a short time be no end of this kind of underhand work, which is sure to disorganize the entire working force, and cause loss to employer. It is the duty of a foreman to see and know what his workmen are doing, and not depend on tattlers to tell him. There are sailors who never go on a voyage without causing a mutiny of the crew of the vessel upon which they ship, and there are workmen who as soon as they get into a shop begin to make trouble among the men by finding fault with the hours of working, rules of the shop, foreman, tools, wages, etc., last but not least, talk "union and strike." Such men always find listeners and sympathizers among workmen, and make no end of trouble for both employer and workman. These men are born mischief-makers, like the sailor who induces crews to mutiny, and should be discharged as soon as their peculiar characteristics are learned, and never again employed. When a workman is discharged he should be let go as easily as possible and not accused of being a poor workman or a mischief-maker before other workmen, for he may have done good work in another shop and been a quiet inoffensive man who minded his own business or at least he can get men to swear he was, and the employer may get a suit on his hands for damages for giving him a bad name and preventing him getting employment. Avoid this by simply informing the man work is slack, or his services are no longer required.

There is nothing to be gained by quarreling with workmen, either in or out of the shop, and the less the employer does of it the better off he will be. Every precaution should be taken to prevent a plant getting the name of being a hard place to work, for when a shop gets the name or reputation of being a "hell of a place to work in," desirable workmen avoid it, and a class of men is collected that frequently makes things hot for employer and foreman.

Don't confine yourself to home workmen for a man who has traveled and worked in various shops knows more than one who has not and may be able by some simple device to greatly increase your output and profits. Always discharge apprentices when their time is out, and send them out to work in other shops for at least a year before giving them employment as journeymen. This makes them better workmen, and so shows them that the shop can be run without them, which is a very important item in some instances.

A foreman should be employed who is a first class workman, for if he is not, he cannot judge whether the work is being properly done or not; must depend upon others for this information and may be imposed upon by the entire working force under his charge.

A foreman should be given full charge of

the men over whom he is foreman, and his employer should only communicate with the workmen through him; for it is only by this means that the foreman can exert a proper influence and control over his men, and the employer can hold his foreman responsible for results or work turned out.

An employer or foreman should not employ exclusively men of his own nationality or religious conviction, for when this is done, the plant gets the name of the Dutch shop, the Irish shop, etc. This prevents workmen of other nationalities applying for work and limits the employer to one class of workmen, and when the plant is dependent upon a local trade, frequently injures its business.

Besides these objectionable features, workmen of one nationality or religion are more likely to click together, and work against a foreman or employer, than a shop full of men of different nationalities or religions; and an employer who confines himself to one class of men may find his output very much reduced by such clicks, and himself powerless to remedy the evil.

The preference given to Welsh miners over the Irish miners by Welsh mine bosses in the anthracite coal mines resulted in the organization of the Molly Maguires, the murder of a number of mine bosses and execution of many of the Molly Maguires.

To break up the condition induced by this preference shown by the mine bosses to men of their own nationality the coal mine operators were compelled to import miners of a variety of nationalities and to eliminate both the Irish and Welsh control in the coal fields.

This same condition of affairs may be induced to a greater or less extent in isolated manufacturing plants by a foreman giving employment to men of his own nationality when work is slack, as did the mine bosses.

This should be avoided, and work divided evenly in slack times, if it is desired to retain the whole working force for better times.

Clannishness should never be permitted in the management of a manufacturing plant.

The following changes have been made in the management of the American Steel Foundries Co.: Robert P. Lamont was chosen first vice president to succeed Geo. B. Leighton and Geo. E. Scott was chosen third vice president to succeed W. V. Kelley. Mr. Kelley was elected president not long ago.

A ROLL-OVER MOLDING MACHINE.

There are many castings having deep cored pockets which can be made on a molding machine having a roll-over attachment so as to form the green sand core and then roll over the mold and draw the pattern off from the core. The casting shown in Fig. 1 belongs to this class. A series of such castings were required from 14 to 20 in. in diameter and the metal around the core is thin and has to be of exact thickness. To meet this demand, a machine has been developed which is suitable for a large variety of work requiring deep drafts and exact castings. The machine used for forming the drag is shown in No. 1, Fig 2, with the cope in position, showing the tall green sand core.

The cope for this mold is formed on an

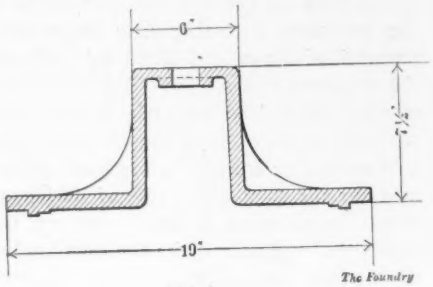


Fig. 1

ordinary straight draw machine fitted with a stripping plate, as shown in Fig. 3.

The roll-over machine, shown in Fig. 2, has a tilting table A controlled by a hand wheel, shown at the left. The table is held in a horizontal position by a latch entering either of the two slots B, which are diametrically opposite on the disc attached to the one end of the table. The various sized patterns are mounted on the table.

In the base of the machine is located an air cylinder, by which the platen C, No. 2, Fig. 2, is raised and lowered. On either side of the platen there is a slide F working on rolls on which the flask rests when lowered away from the pattern. These slides F, F permit the drawing of the flask from under the table so that it can be easily lifted and carried to the floor.

In making a mold the table is first turned to the position shown in No. 4, Fig. 2; the flask placed upon it and locked down by means of the eccentric levers L, shown in Nos. 2 and 3, Fig. 3. The flask is filled with

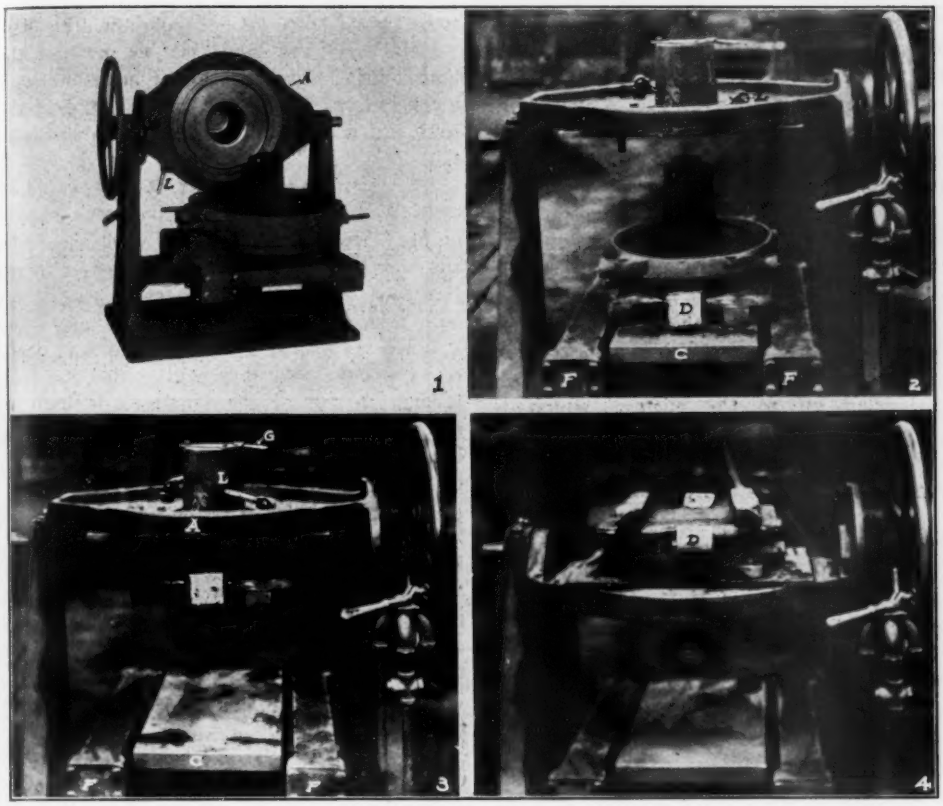


FIG. 2. NO. 1. ROLL OVER MACHINE WITH PATTERN VERTICAL. NO. 2. MOLD ROLLED OVER AND FLASK DROPPED DOWN. NO. 3. FLASK ROLLED OVER. NO. 4. FLASK READY TO ROLL OVER.

sand and rammed in the usual manner. Care is taken, however, to ram it so lightly that no venting will be required. When completed the follow board is clamped upon the flask by two sheet metal clamps C. The latch at the side of the machine is then released and the table A rolled over, as shown in No. 3, Fig. 3. The platen C is raised by the air cylinder until it comes in contact with the follow board when the clamps L are released. To allow the air to enter above the core as it is drawn, the gate G, No. 3, Fig. 3, which covers a vent in the bottom of the pattern, is open, so as to admit air freely. The flask is then lowered by means of the air cylinder to the position shown in No. 2, Fig. 3; No. 1 also showing the same condition, except that the mold has been drawn forward and the pattern plate turned to a vertical position.

The flask rests on the sides F when in its lower position, and hence can be easily drawn forward, removed and placed on the floor. The three way cock for controlling air is shown at the right of the machine, No. 3, Fig. 3.

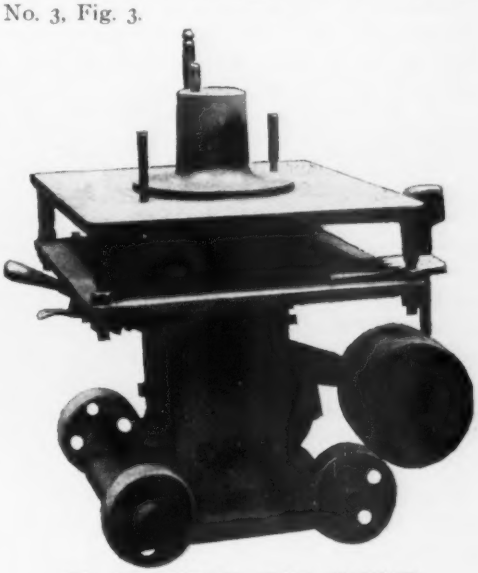


FIG. 3.—STRIPPING PLATE MACHINE.

When making the molds the roll-over machine is mounted at one end of the floor and produces the drags. A standard machine, like that shown in Fig. 3, is placed on the other end of the floor and produces the copes. The standard machine is mounted on wheels so that it can be moved as required. The working parts of the standard machine consist of a square hollow plunger which slides vertically between adjustable brass guide strips, and is moved by a hand lever clearly shown at the left of the machine. The stripping plate is supported by four adjustable corner posts so that it can be leveled up to the pattern which is mounted on the plunger. Arrangements can be made on the standard machine for stooling the center or any part of the stripping plate, though no stools are used in the case illustrated.

The machines shown are made by the Taylor-Wilson Co., of McKee's Rocks, Pa. The roll-over machine is a special type developed by them, and the other one their standard molding machine which was developed in connection with their own work.

Slagging a Cupola.

To the Editor of *The Foundry:*

The article on "Slagging a Cupola," by Mr. Rogers, in the September number, puts the matter on a strictly scientific basis and forms an admirable guide for the true method of figuring a cupola slag. But for ordinary foundry practice, the method is too technical, and few mixers of iron would want to make the necessary calculations.

Mr. Rogers figures the slag on the subsilicate type. This in ordinary language means a cinder with much more lime and alumina than silica.

A cinder of this kind means more lime than is needed to make a fusible slag. A very good cinder is more commonly made on the monosilicate type, which means about equal quantities of lime, etc., and silica. By figuring out a slag on the monosilicate type much less lime will be needed and the results will be just as good and you will not waste fuel by melting up an extra amount of lime.

In a paper I wrote for *The Foundry* I advocated putting in 20% limestone with every charge of coke; this makes a fusible cinder with very little iron in it.

In our large cupola we use 700 lbs. of limestone with 3,600 lbs. of coke on the bed.

With scrap and sandy pig we increase the lime a little, using 200 lbs. of limestone with a coke charge of 800 lbs. This is 25% of the coke and will make practically a monosilicate slag.

The limestone used by Mr. Rogers would be considered very poor. No limestone should be used over 3% in silica. If coke should be run very high in ash it would be better to reject such coke rather than try to slag it off with a large amount of limestone.

When more than 25% of limestone is needed to flux the coke it is evident that the coke is high in ash or the limestone is high in silica. Rather than dose the cupola with a larger amount of lime it would be better practice to get good coke and good limestone.

It is not possible to reduce the sulphur to any great extent by the addition of limestone, the great amount of iron in the cupola will absorb most of the sulphur in spite of the lime present. Therefore the calculation of the amount of lime is recokoned most simply by the following:

With clean iron use 20 lbs. of limestone with every 100 lbs. of coke.

With sandy iron use 25 lbs. of limestone with every 100 lbs. of coke.

W. W. SHED.

A Work on Malleable Iron.

Inquiry.—Has Dr. Moldenke or any other authority written a work on malleable foundry practice, which will be of service in making mixtures?

Answer.—Dr. Moldenke wrote a section on malleable casting for the shop and foundry course of the International Correspondence Schools, of Scranton, Pa., and it has been published in connection with the course. These books can be obtained either by purchasing the course mentioned or by purchasing volumes of the Library Technology, also published by the International Correspondence Schools, but in either case the expense is considerable, as several volumes have to be purchased. At present there is no other work on malleable practice that we know of.

The Proctor Foundry & Machine Co., Gadsden, Ala., has been incorporated to continue operating the plant of the Gadsden Car & Machine Co. The daily capacity will be about 25 mining cars. Robert Proctor is the engineer in charge.

ASSOCIATIONS AND SOCIETIES.

New England Foundrymen's Association.

Fred F. Stockwell, Secretary, care of the Barbour-Stockwell Co., Cambridgeport, Mass.

The regular monthly meeting of the New England Foundrymen's Association was held on Wednesday, Oct. 11. Through the courtesy of the United Shoe Machinery Co. a visit was made to their plant at Beverly, Mass. The members were received by the officials of the company, after which an inspection was made of the plant. A corps of men were on hand to properly direct the throng through the works, which are far famed for their completeness and modern equipment, and explanations were given by the staff of the establishment, which aided a thorough understanding of the systems of work involved. Returning to Boston each member was presented with a beautiful souvenir brush.

Upon arrival in Boston the members proceeded to the Exchange Club where dinner was served at 6 o'clock. After dinner the usual routine business was disposed of, President John Magee presiding.

Report was received from the committee appointed to canvass for an increased membership and attendance at the meetings, and same was accepted as progressive.

Report was received from the committee appointed to prepare resolutions upon the death of Mr. Alva Carpenter, and same was accepted and ordered spread upon the records as follows:

WHEREAS, An Allwise Providence has removed from our midst a much beloved friend and fellow-member, Alva Carpenter, and

WHEREAS, By his genial disposition, courteous manner and hearty fellowship he endeared himself to all with whom he came in contact, therefore be it

Resolved, That we, The New England Foundrymen's Association, in convention assembled, express our deep regret and record our high appreciation of the sterling qualities of his character and his unusual efficiency in his chosen line of business, which made and retained for him so many friends; endearing him to us and leaving with us pleasant memories of his life.

Resolved, That in his death this association has sustained the loss of a valuable friend, and its members individually an associate whose friendship was prized among the choicest of their business acquaintances.

Resolved, That we extend to his family our deepest sympathy in their great affliction and our condolence in this their season of grief.

Resolved, That these resolutions be spread upon the official minutes of this association and a copy of same sent to the widow of our departed friend.

The president then introduced Mr. Leonard C. Wason, of the Aberthaw Construction Co., who gave an illustrated talk along the lines of different types of construction for foundries, showing buildings in process and methods of construction. The president also introduced Mr. Frank W. Reynolds, of Lockwood, Greene & Co., Boston, who made remarks pertaining to the same subject.

At the conclusion of the remarks a unanimous vote of thanks was extended to both speakers.

On motion a unanimous vote was also extended to the United Shoe Machinery Co. for the extreme courtesies shown the members while visiting their plant during the afternoon session.

There being no further business the meeting adjourned at 9 p. m.

Philadelphia Foundrymen's Association.

Howard Evans, Secretary, care J. W. Paxson Co.

The 150th meeting of the Philadelphia Foundrymen's Association was held at the Manufacturers' Club, Philadelphia, on Wednesday, Oct. 4. The meeting was called to order by President Thomas Devlin at 8:30 p. m., with 33 members and visitors in attendance. The report of the treasurer, Mr. Josiah Thompson, was submitted by the secretary, showing a balance of $1,893 on hand, all bills having been paid. As announced in the notice for the meeting, President Devlin gave a brief resume of his recent trip abroad, enumerating the various cities which he had visited in Europe, and giving a general description of the places of interest, after which a short discussion was participated in by several members on the subject of local business conditions, which were reported as very good. Mr. George C. Davis, the official chemist of the association, stated that a remarkably small amount of the samples sent to him were subject to dispute, and as a rule iron is pretty satisfactory, although the same could not be said of coke. Coke contains fully as much sulphur and sometimes a little more. The paper for the evening was read by Mr. S. Newbold, of the Tabor Manufacturing Co.,

Philadelphia, and is published on another page of this issue.

President Devlin being called away, the meeting was presided over for the remainder of the evening by Dr. Brown. In reply to a question as to whether the machines shown on the screen were specially designed to carry the Taylor-Newbold saw, Mr. Newbold said that the steel founders' saw is the standard design No. 2 machine, carrying a 50-inch blade. It is a regular machine and not special in any way. We have taken quite a number of machines without making any changes whatsoever, putting on a Newbold blade and increasing the productive capacity (say) from 50 to 70 percent. Where an ordinary solid blade is cutting ⅛ to ¼" per minute we are cutting from 1⅛ to 1¼. There is absolutely no change. The machine was constructed in such a manner that it is practically capable of taking care of the Newbold saw. No changes have been made unless it has been to double up the feeding capacity. You get the full benefit of the blade if you go over the machine and see that all the bearings are in good condition. The class of men who operate a cold saw cutting off machine generally know nothing about a machine tool or its use. I have a case in mind where the Newbold saw was put on an old steel foundry machine in operation seven years. They found they could not get as much out of the saw as they ought to. They were cutting off a four-inch gate in eight to nine minutes. I found that the whole foundation lifted up. There was about a thirty-second of an inch side play. This was a disadvantage to the tool. After eliminating all that lost motion we were able to cut off four-inch gates, four to six inches in diameter, in six minutes, which was an increase of 75 percent over the previous time.

A vote of thanks was extended to Mr. Newbold for the presentation of the subject, after which Mr. J. W. Daniels, of the Atlantic Refining Co., explained how a new process for producing castings of a difficult or intricate nature was brought to his attention. He exhibited several samples of extremely fine work and stated that the process would be fully covered in a paper prepared by the inventor which would probably be presented at the next meeting of the association.

Pittsburg Foundrymen's Association.

F. H. Zimmers, Secretary, care Union Foundry and Machine Co., West Carson Street.

A paper on "Partamol," parting made by the Partamol Co., New York, by Wm. Dinkelspiel, of the company, and a discussion of the recommended specifications for cast iron occupied the attention of the Pittsburg Foundrymen's Association at the regular meeting held Monday evening, Oct. 2, at Engineers' Hall, Pittsurg.

Partamol is a parting compound which has given excellent results in intricate and fine castings. It is dusted on very sparingly and "stays put." In the discussion Mr. B. D. Fuller remarked that while the cost of lycopodium was constantly advancing, and had now reached about a dollar a pound, it did not stand at as great disadvantage with Partamol at 20 cents a pound as might be supposed, as he took it the relative specific gravities were about as 1 to 4. Mr. Dinkelspiel stated in reply that the relation was about as 2½ to 1, and that his company was constantly improving the character of Partamol so that it would absorb less moisture.

The discussion on "Recommended Specifications for Cast Iron" could not be carried out, as Mr. H. E. Field, who was to lead the discussion with Mr. A. W. Slocum, had been called out of town.

Mr. Slocum presented a discussion of the specifications adopted last summer by the American Society for Testing Materials, from the standpoint of the car wheel manufacturer. He pointed out that while the specifications adopted were quite rigid the railroads would still demand a guarantee of service, 80,000 miles, so that the car wheel maker would have to serve two masters. Then, further, the analysis of 2.90 percent graphitic carbon and 0.60 percent combined carbon, does not, in Mr. Slocum's opinion, conform with the requirements of chill, not under ⅜ inch nor more than ⅞ inch, inasmuch as to conform with other conditions, the manufacturer would be forced to work up close to the maximum of chill, and to produce such a chill would be almost a physical impossibility, with the required percentages of graphitic and combined carbon. He mentioned some satisfactory wheels which had 1.30 percent of combined carbon and insisted that none of the car

wheel makers were producing wheels of less than 1.00 percent combined carbon. If wheels do not stand a service of five years the manufacturer is liable to pay a penalty of $2.00 per wheel. The drop test was also objected to, as the other requirements should guarantee good wheels, and the drop merely wasts a wheel for each lot.

The provision that wheels bearing date more than 30 days prior to inspection will not be accepted, except by special permission, is, in Mr. Slocum's judgment, a hardship on the manufacturer. It frequently happens more wheels are made than are needed on an order, and it should not be made so difficult for manufacturers to carry them. The permission to submit older wheels, while obtainable, is only obtained as a special favor, and manufacturers are likely to wear out their welcome while preferring to save the spirit of accommodation on the part of the railroad superintendent for other purposes.

On account of wear of chillers, the shrinkage test required would necessitate the replacement of chillers every six months or so, when under previous conditions they can be used for two or three years.

Special criticism was made by Mr. Slocum of the requirement that wheels will be considered to have failed which "do not conform to standard design and measurement." He asks: "Is there a standard?" There is the M. C. B., the Harriman, the Big Four, the Pennsylvania, the four distinct standards of the Baltimore & Ohio, etc.

Following this partial discussion of the subject, the association arranged for committees to work up the matter, appointing Mr. H. E. Field chairman of a committee on standard specifications in general, and A. W. Slocum as chairman of a committee on car wheel specifications in particular, each chairman to appoint four members to make up a committee of five.

The nominating committee presented the following names of gentlemen to serve as officers and committee members during the ensuing year:

President: B. D. Fuller, Westinghouse Electric & Mfg. Co.

Vice president: Henry J. Spilker, Sterrett-Thomas Foundry Co.

Treasurer: J. S. Seaman, Seaman-Sleeth Co.

Secretary: F. H. Zimmers, Union Foundry & Machine Co.

Executive committee: W. H. McFadden, J. S. McCormick, S. D. Sleeth, John Phillips, G. C. Shade.

Program committee: E. D. Frohman, A. W. Slocum, H. E. Field.

The chairman announced that Mr. Seaman had hoped to be present, but was prevented by sickness in the family, and had made an earnest request that he be relieved from further duties. It was decided that Mr. Zimmers could act as treasurer, and an election was made on the above basis, Mr. F. H. Zimmers being elected both secretary and treasurer.

Buffalo Foundrymen's Association.

John E. Gross, Secretary, 23 Builders' Exchange.

On Tuesday, Sept. 19, the first regular monthly meeting of the Buffalo Foundrymen's Association, following the customary summer recess, was held in the association's new and commodious quarters, 685-687 Ellicott Square.

President Lyman P. Hubbell was in the chair, with 26 members present. The following applications for membership were acted upon favorably:

American Locomotive Co. (Brooks Works), American Malleables Co., Niagara Foundry Co., Lake Erie Engineering Works, McKim Foundry & Machine Co. and F. B. Howell.

The association now having a membership of 35 foundry firms, is in a very healthy and prosperous condition.

As a special feature Mr. J. C. Bradley, general superintendent of the Pratt & Letchworth Co., gave an informal talk on "The Selection and Training of Apprentices," which proved to be one of the most instructive and entertaining that the association members have ever had the pleasure of listening to. With 25 years' experience in the molding business as a basis for his remarks, Mr. Bradley entered into his subject from the practical view point of personal interest in apprentices.

He explained in detail the method adopted by his firm through which they select, educate and turn out many of the most proficient molders in this country. His great success in this particular work is due to the personal interest he takes in the boys in first selecting those who show an ambition to succeed and to educate them to appreciate the advantages of the molder's trade. He does not place them in charge of a molder who does everything in his

power to discourage them, and takes little or no interest in them, but sees to it himself that they are advanced and educated in all branches of molding, so that when they have completed their apprenticeship they are qualified to do high-class molding and earn top wages.

Erie Foundry Foremen.

W. F. Grunau, Dist. Vice Pres., care Erie City Iron Works.

The Erie Foundry Foremen held an enthusiastic meeting on Oct. 2, after the regular business. James A. Evans, of the Erie laboratory, gave a talk on the benefits to be derived from chemical analysis of the materials used in the foundry. Mr. Evans is a very interesting speaker and the members hope to have him with them again soon.

During the winter months each member of the club is expected to prepare a paper on some foundry subject. It was decided to hold a smoker on Oct. 16.

Joint Meeting of the Cleveland Foundry Foremen and the Cleveland Foundry Foremen Patternmaker Associations.

On Saturday, Oct. 7, there was a joint meeting of the two associations, which was attended by a number of members from each organization. Mr. A. L. Hott, president of the Foundry Foremen's Association, called the meeting to order, and Mr. J. Nall, secretary of the Patternmakers' Association, acted as secretary of the meeting. First, some business relating to the Foundry Foremen's Association was transacted, after which the committee having charge of the joint outing to Put-in-Bay on Saturday, Aug. 26, made a report, showing that the total receipts were $170.15, while the total expenses incurred were $124.46, leaving a balance of $45.69. After considerable discussion it was decided to divide this amount between the treasuries of the two associations. It was also the general consensus of the meeting that the Foundry Foremen would make this a nest egg for the entertainment fund to be used at the time of the A. F. A. convention, which is to be held in Cleveland in June, 1906. After this several matters were discussed, among which was the advisability of forming a class in foundry metallurgy among the members of the association.

After the transaction of the business, Mr. J. H. McCaslin, of the Wellman-Seaver-Morgan Co., gave a very interesting talk on the making of castings in cores, the core boxes for which were made from iron patterns by reverse molding with plaster of Paris. All of the plaster models necessary for the production of a set of core boxes were shown. After the presentation of papers there was considerable discussion upon the subject.

Mr. Nall then spoke at some length of the relationship between the foundry and the pattern shop. After the regular program there was considerable discussion as to the best methods of making the meetings interesting and getting the members to attend. This resulted in the appointment of a special committee from the Foundry Foremen to arrange some special entertainment for the next meeting.

Chicago Foundry Foremen.

Mr. Thompson, Link Belt Co., District Vice President.

The regular meeting of the Chicago Foundry Foremen was held Sept. 16. After the transaction of the routine business, Mr. Kohleman, of the Sturtevant Blower Co., read a paper on "High and Low Blast Pressure in Modern Foundry Practice." The paper was followed by considerable discussion, showing a lively interest in the subject. The majority of the members seemed to favor a rather low blast pressure.

It was announced that the next meeting would be held Oct. 19, at the Lewis Institute, when Mr. I. S. Robinson, of Camden, N. J., will deliver a paper on "Sand," illustrated by stereotype views.

Milwaukee Foundry Foremen.

Sol. Shaw, care Clinton Street Foundry of Allis-Chalmers Co., Secretary.

The monthly meeting of this association occurred on Monday evening, Oct. 2, with the president, Wm. Beck in the chair. After the regular business had been transacted, the president addressed the club, stating that he felt that a great many foundrymen, who knew the business thoroughly, were unable to get up in a meeting and express their views in public. In other words, they are extremely backward about coming forward. As the result of the discussion which followed, it was decided to open a question box into which any member could place a slip upon which he had written a question, but without signing his name. It is hoped that these questions will be discussed by all and a good many valuable points brought out.

There was also a discussion concerning the advancement of the foundries in general, and one of the members stated that a certain salesman in other lines made the remark recently that outsiders generally think that the foundries of today are not as up-to-date as the machine shops and other manufacturing plants, which are turning out improved goods in large quantities. This provided a very lively discussion, and there was so much to say upon the question that it was decided to lay it over until the next meeting.

THE ASSOCIATED FOUNDRY FOREMEN.
Frank C. Everitt, care the J. L. Mott Iron Works, Trenton, N. J.

NEW YORK FOUNDRY FOREMEN'S ASSOCIATION.
C. H. Thomas. 14 Elizabeth St., So. Norwalk, Conn., District Vice President.

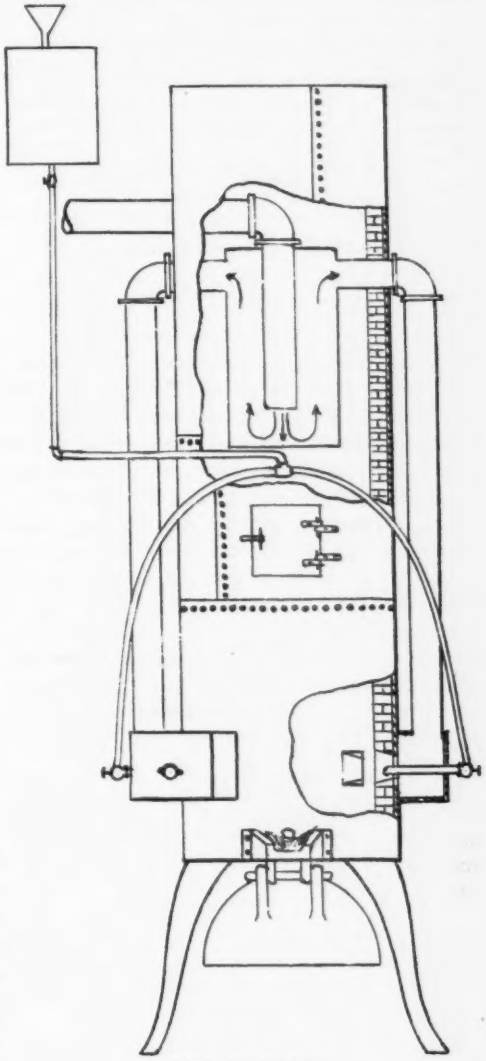
INDIANAPOLIS FOUNDRY FOREMEN.
W. S. Keller, of Hetherington & Berner Co., District Vice President.

CINCINNATI FOUNDRY FOREMEN.
E. W. Cadwell, Secretary.

HAMILTON, ONT., FOUNDRY FOREMEN'S ASSOCIATION.
A. Chase, care Sawyer & Massey Co, Secretary and Treasurer.

THE HOLLAND CUPOLA.

Many attempts have been made to utilize some of the heat escaping from the cupola and return it to the furnace. As the iron begins to melt in the cupola it has to drop down through the fuel between the melting zone, and the tuyeres in the shape of small shots or drops, and during this time is subjected to the cooling action of the blast. Many also claim that during this descent more or less sulphur is absorbed. The blast burns out some of the carbon, thus cutting down the free or graphitic carbon, and the sulphur absorbed also tends to make the iron hard. The first iron tapped from the cupola is usually harder than that which comes later, owing to the fact that after the iron has been flowing a little while ducts or passages form through which the iron flows protected by a layer of slag. The melted iron keeps these passages during the entire heat. To overcome the chilling action of the tuyeres, to make the cupola melt faster, and to economize heat, the Holland cupola has been invented. The accompanying illustrations show a diagram of a cupola equipped with this device. The drawing is not aimed to be made to the scale, the charging door being represented simply by a small door. In the stack above the charging door is suspended an iron casing into the top of which a pipe from the fan is led. The cool air is forced to the bottom of the casing and rises from there to the top. In this way it is heated to a considerable degree. To still further increase the efficiency an oil tank is arranged at one side, and oil pipes led to the tuyeres so that oil may be sprayed or atomized into the tuyere with the heated air. The oil and hot



HOLLAND CUPOLA.

air enter to produce very intense heat. This tends to bring the melting zone down closer to the tuyeres so that the iron has less distance to travel after it is melted on its way to the sand bottom. It is also exposed to less oxidizing and chilling action on account of the presence of the oil in the hot blast.

The cupola described is known as the Holland cupola and is manufactured by O. W. Werntz & Co., Warsaw, Ind.

METALS IN FOUNDRY PRACTICE

Devoted to inquiries from Practical Foundrymen on subjects relating to the Melting and Using of Cast Iron, Steel, Brass and Bronze.

The following experts answer questions in this department:

W. J. Keep, Cast Iron.
J. B. Nau, Metallurgy of Steel and Steel Castings.
Dr. Richard Moldenke, Malleable Castings.
C. Vickers, Brass Castings.

We have also made arrangements with several others to act as special contributors upon Brass, Bronze and other subjects. All inquiries should be addressed to the Editor of THE FOUNDRY, and they will then be forwarded to those in charge of the different subjects.

CAST IRON NOTES.

BY W. J. KEEP.

A Curious Cupola Experience.

This time it was in our own foundry. Just after the iron came down the foreman called me to see what was the matter with his cupola, and thought he had better shut it down. A clear blue smoke completely filled the air. The smoke came out of the tap hole and followed the surface of the iron until it turned over the end of the spout, when the smoke curled up and spread out over the front of the cupola. The men were afraid of an explosion and wanted to go home. There was no odor to the blue cloud but for half an inch above the stream of iron on each side of the spout there was a brilliant black line about half an inch wide with a straight, sharply defined edge and the clay of the spout was not colored above this line. As each man returned for more iron his ladle was perfectly black, like the black head of coke.

The iron was very soft and had no chill. Our two other cupolas were running as usual without any of the smoke or other peculiar indications. The materials so far as we then knew were the same in each.

The smoke in the one cupola was much greater at the charging door and continued 2½ hours throughout, the heat growing somewhat less towards the last.

When the bottom was dropped there was much more charcoal than ever before left from the kindlings.

An investigation next day showed that a barrel which had been left by some roofers and had considerable asphaltum adhering to its sides, had been broken up and used for kindling.

Iron is always kept several inches above our tap hole and it is curious that asphaltum could work down through melted iron, and that it would not burn or volatilize during a 2½ hours' heat.

A Steam Jet in a Cupola.

Question.—I am very desirous of finding out the advantage of blowing steam into a cupola. Having made unavailing inquiries in several directions I write to you in the hope that you will be so good as to favor me.

Answer.—If there was any advantage in blowing moisture in any shape into a cupola, it would have been discovered long ago that better melting could be done on days when the air was filled with mist. It is claimed by some that super-heated steam has merits, but the instant that such steam enters the cupola along with the cold air blast it becomes a fine spray of cold water. I have tried steam in many ways and have never found any benefit whatever, and have at least imagained that the iron was not as hot as without steam. The reason that there is sometimes a seeming advantage in using steam is that the representative of the steam jet claims that more scrap can be used with steam than without, therefore he uses the ordinary mixture without steam and more scrap with steam and then claims that the increase in strength and economy is due to the steam, whereas it will be found that the same amount of scrap can be used without steam and that the same increase in strength and economy can be obtained.

It is claimed that the steam is changed by the intense heat of the cupola into hydrogen and oxygen, and that these gases by again uniting, will then increase the heat. For the past fifty years fortunes have been spent in trying to "burn water" in this way, but failure has always been the result.

It takes more heat to separate the gases than they can produce by again uniting, because there is loss of heat in making any such change. The tuyere is the coldest part of the cupola and there is no heat to spare even at the melting point. Coal or coke burned in air produces carbonic acid, which is dry, but the union of hydrogen and oxygen produces steam again, which carries away a large amount of heat. Advocates of the steam jet have exhibited pieces of stove plate iron punched with all sorts of holes and have claimed that none but castings produced with steam will stand such punching.

It will be found that any soft iron cast thin can be punched as well without being cracked.

Nature's Measure of Quality.

The determination of the chemical composition of a casting enables an expert to closely judge of the quality of a casting, and by quality is meant the shrinkage, the hardness and the grain. The variation in opinion as to the influence of carbon, graphite, combined or the quantity of phosphorus, sulphur or of manganese, shows that the influence of each of these elements varies under varying conditions. The influence of silicon is quite generally agreed upon and will soften and reduce shrinkage and hardness, but the founder cannot tell the percentage of silicon in his casting or in the irons entering into it without an analysis of each and this can only be done by the chemist at considerable expense and delav. Nature has, however, provided the simplest test for the ordinary founder. Castings having the same shrinkage if of substantially the same mixture are of uniform quality.

If the shrinkage increases the silicon is less, the hardness greater and the grain closer and *vice versa.*

If a founder measures the shrinkage of a standard test bar each day, or at any part of a heat, if the shrinkage is greater than his standard he should increase silicon to bring it back and *vice versa.*

This is nature's guide to the founder and it is quick and without expense.

BRASS FOUNDRY NOTES.

BY C. VICKERS.

Cores for Brass Castings.

Inquiry.—We have had trouble lately with some brass castings which contain a large amount of core work. The cores measure roughly 3 x 4 x 2 in. and the castings come out very rough on the inside. The molder claims that to use a wash prevents his brass from running, and I contend that his wash is not of the right kind. Can you please give some information upon this subject?

Answer.—In order to return an intelligent answer to this question, the thickness of metal around the cores should have been stated, also the mixture of core sand used. If these cores are surrounded by from 3 to 4 in. of metal or more, the pressure will force the metal into the cores, unless they are protected by a "wash." A fine grade of plumbago mixed with weak molasses water should be used. The core should be thickly coated and dried, then given a second coat, a third or fourth coat may be necessary where the enveloping metal is over 4 in. in thickness. The cores should be well dried, and a flour binder is as good as anything in this case.

With less than 2 in. of metal no wash should be necessary. A linseed oil core should be satisfactory, or glue may be used. Take seven parts fine, sharp sand to three of molding sand; dampen slightly with water, then temper to a proper dampness for use, with liquid glue made as follows: Dissolve 1 lb. of glue in two quarts of water at a gentle heat, add, when cool, 1 oz. nitric acid. The glue will then keep indefinitely and is always ready for use.

Some cores may need more molding sand than the above, others less, and they can be made as strong as desired by using more glue and less water in mixing the sand.

A heavy coating of plumbago or other wash, will sometimes check the flow of brass, by causing a "blow" on very thin castings (3-16 or less of metal).

A glue core made as above used without any wash should be satisfactory.

C. VICKERS.

Government Bronze.

The writer recently visited a foundry where they were making what they called government bronze. The castings came out of the sand as smooth and clean as a new coin. None of the sand seemed to adhere to them. The color was that of medium gold. The grain where the gates were sawed off was very fine, and they say that the tensile strength was exceedingly high. Judging from the appearance, I am of the same opinion. They also intimated that these castings contained approximately, copper, 55 percent; zinc, 44½ percent; and tin, ½ percent.

Can you inform me if this mixture will produce such results, and if not, do you know a mixture of approximately the same cost that will produce the results? Also please state the conditions under which the mixture should be melted, molded and poured.

Answer.—The alloy mentioned is of a deep yellow color, if made of new metal it will leave the sand quite clean, but its tensile strength is not high and there is no bronze or brass that I know of that can be made as cheap, that will give a high tensile strength. I am inclined to think the formula was not correctly given from your description. The alloy undoubtedly contained aluminum, which would improve its strength and appearance.

METALLURGICAL NOTES.

BY L. G. BLUNT

Iron for Pipe Fittings.

Question.—What do you consider an ideal analysis of pig iron from which to make high-pressure pipe fittings?

Answer.—This question cannot be intelligently answered unless more information is received as to the amount of metal you pour per day, and the capacity of your melting department. Can you melt the iron for the large work in one cupola and for the small in another; or if you only have one cupola can the large work be poured first or do you have to pour large and small at the same time?

For specialty work such as yours I should advise keeping all of the elements, which have a bearing on the characteristics of the casting constant except one, and get the desired results by varying it. I should let the total carbon be the variable. In such a case the following analysis for the castings should be aimed at and can be hit with surprising accuracy, with a little practice if your melting department is arranged properly for such work:

Si 1.75%; S .08%; P below .2%; Mn .5%; T. C. 2.75 to 3.50%.

The high total carbon is for small work and the low for the large work.

How to get this analysis and whether total carbon is the best element to vary depends upon your cupola layout, as stated before. L. G. BLUNT.

An Aluminum Pattern.

Question.—I wish to make some herring bone grate bar patterns of aluminum. The high coefficient of shrinkage that aluminum possesses may cause the castings to crack, therefore I should like to know whether the addition of any element would reduce it? Also what is good aluminum worth and where can I get it?

Answer.—The shrinkage of aluminum castings may be slightly decreased by the addition of nickel or tin. The shrinkage of cast aluminum is .2031 inches per foot. This may be reduced about .02 of an inch by the addition of 10 percent of either of the above named metals.

The Pittsburgh Reduction Co. makes a special casting alloy whose coefficient is .1718.

I think, however, that this casting can be made in one piece from pure aluminum without any trouble, and I should try it anyhow. If the ends were made separate and fastened on afterwards as shown by the dotted lines in the sketch I am sure it would not crack.

The Foundry

The mold can be made of green sand if it is open and well vented. The sand should be worked as dry as possible and no dressing or facing should be used on the mold. Incline the mold so that there will be no air traps and pour fast with a high head.

Good metal can be obtained from the Aluminum Reduction Co., of Niagara, N. Y., and is worth about 32 cents per pound.

A good shrinkless metal pattern may be made with the following mixture:

One part of copper to one and a half of antimony and ten of tin.

L. G. BLUNT.

Cupola Dimensions.

Question.—What are the best size tuyeres for a 48-in. cupola, how far above the bottom doors should they be placed and how should such a cupola be charged for ordinary work?

Answer.—Let the bottom of the tuyeres be 18 in. above the doors. They should be 3 in. wide extending all the way around the cupola.

To charge such a cupola, the sand bed should be 3 in. deep. The coke bed should extend, after it has been blown up, 24 in. above the top of the tuyeres. Charge 3,500

lb. of iron on this and let the succeeding charges consist of 300 lb. of coke and 2,400 lb. of metal. The blast pressure should be 9 oz. 20 minutes after starting. (I assume that your charging door is 16 ft. above the tuyeres.)

It will be found that the low melting ratio, which the writer recommends, will decrease the hourly melting capacity of the cupola, but the practice of melting at a 10 or 15 to 1 ratio and about as fast as an army of men can put the material in at the top is a penny-wise, dollar-foolish method in his estimation. L. G. BLUNT.

Wax Wire.

There are some points in which the European foundry practice is ahead of our American practice, and the writer believes that it would pay American foundrymen to look into many of these European improvements.

For venting difficult cores, wax wire has been used in Europe for a long time with very great success. The product is just beginning to be introduced into the United States, and while many foundries are experimenting with it, or using it in a small way, the majority of them do not even know of its existence. Most of the wax wire used in Europe is made from black wax in the center of which there is a thin thread. The thread tends to hold the wax together as the core is being rammed, thus insuring a continuous vent. The wire is placed in the core just as a vent rod would be, except that it does not have to be straight, but can follow the curved outline of the core box. When the cores are baked, the wax melts and forms part of the core sand bond. Wires of this class are sold in this country by Messrs. Alfred Field & Co., 93 Chambers street, New York city. Wax wire is also made without the thread and some foundries have presses for forming such wire. For use in presses either white or yellow wax is usually employed. A READER.

Pickling Tanks.

The writer would like to ask what experience other foundrymen have had with pickling tanks. We have used wooden tanks for holding sulphuric acid, and find that they do not last long; the vitriol seeming to eat through them or rot them very soon. We should like to know if any one has found anything better, and if any one can advise us as to the best way of constructing such tanks. We use a lead lining in our tanks, but even then the wood is soon destroyed. Has any one had experience with the use of cement tanks, and if so, with what success?

A SUBSCRIBER.

Granulation of Metals.

Question.—Will you please tell me how metals are granulated—for instance, zinc and aluminum?

Answer.—Metals are generally granulated by melting and pouring into water. The writer has granulated lead, tin, zinc, iron and copper in this manner. This method makes fair sized shot in the case of iron, but the lead and zinc generally flatten out upon the surface of the water, forming irregular masses. Metal is also sometimes granulated by melting and then agitating it while it is cooling. Grain tin is occasionally made in this manner by tossing the molten metal in a wooden bowl and then screening out the coarse particles. In this way very finely divided metal can be obtained.

HARRY MALONE.

Casting Brass and Iron in the Same Mold.

The writer has been having trouble in making a combination iron and brass driving box wedge. The wedge weighs about 60 pounds and there is supposed to be a half inch of brass on the face. The difficulty I am having is to keep the top or iron part of the shoe free from blow holes or dirt. My method of making this is as follows: The brass is first poured into the mold and let set for about 30 seconds. The iron is then poured in through the same gate. Can any reader of *The Foundry* suggest a method of pouring these which will overcome the difficulty above mentioned?

Production of Molding Sand.

The United States Geological Survey has just published a pamphlet showing the production of sands in the United States for 1904. The statistics show that the molding sand comes principally from Ohio, Pennsylvania, Illinois, New York, Kentucky and New Jersey in the order named. The total production for 1904 was 3,439,214 tons, valued at $2,125,370. Molding sand is now mined so extensively that it has become a factor of export trade. Its value ranges from 35c to $3 per ton.

PERSONALS.

When Mr. John C. Bradley Sr. left his position with the Pratt & Letchworth Co., Buffalo, N. Y., to accept his new position with the Denver Chemical Mfg. Co., of New York, mention of which was made in *The Foundry* last month, the officers of the Pratt & Letchworth Co., tendered him a banquet at the Lafayette hotel, in Buffalo. The office employes and foremen were present and Mr. A. S. Capwell acted as toastmaster. The toastmaster extended to Mr. Bradley the good wishes of those present for his success in his new field. Mr. Bradley responded, after which speeches were made by Treasurer Josiah Letchworth, President O. P. Letchworth, Secretary W. C. Houck, Foreman Gilbert and Manager Hammond, of the Brantford, Ont., branch. The employes of the company presented Mr. Bradley with a handsome diamond ring on the afternoon preceding the banquet, as a token of their esteem for him, and regret at his departure.

Mr. J. C. Loughry has resigned his position with the steel company in Lorain, O., where he has been employed, in order to devote all of his time to a special system of accounting for foundries and manufacturing establishments. The system has been adopted by a large number of firms, both in this country and abroad, and the business of introducing it has grown to such an extent that it will require all of Mr. Loughry's attention to devise special methods for each individual plant. As a token of the high esteem in which Mr. Loughry was held by his fellow employes they presented him, upon his leaving the plant, with a handsome traveling bag and umbrella.

W. H. Lorenz, of Springfield, O., has accepted a position as chemist in the new foundry laboratory of E. R. Caldwell & Co., at Bradford, Pa. The new laboratory has been fitted up with the latest modern appliances.

Patrick McGuire, formerly superintendent of the Johnston & Jennings Co., Chicago, has recently accepted a position as general manager of the Congress Foundry Co., Chicago.

Emil Lungreen, manager of the King & Andrews foundries, at Chicago Heights, Ill., has accepted a position as general manager of the new foundry to be erected at Geneva, Ill., by the Geneva Foundry & Machine Co.

Mr. Eugene McIlvain, of Kenton, O., has accepted the position of foreman of the core department of the East Iron & Machine Co., of Lima, O.

Geo. G. Blackwell, head of the Liverpool house of Geo. G. Blackwell, Sons & Co., Ltd., arrived in New York on Oct. 10 and will visit the principal iron and steel centers of this country. We are sure that Mr. Blackwell will meet with a welcome from his many friends made on previous visits and that he will form new friendships.

Isaac W. Frank, president of the United Engineering & Foundry Co., Pittsburg, has returned from his trip to Europe.

The Youngstown, O., Foundry & Machine Co., announces the appointment of B. G. Parker as secretary and treasurer and H. P. Parrock as assistant general manager.

Thomas Devlin, of Thomas Devlin & Co., Philadelphia, has returned from a trip to Europe.

Frank Bull, president J. I. Case Threshing Machinery Co., Racine, Wis., was seriously injured Sept. 5 by an explosion in his garage. Mr. Bull and his automobile were hurled to the ceiling, his head and face being badly cut. The automobile was wrecked.

Lyman A. Holmes succeeds M. Sims as superintendent of the National Steel Foundry Co., New Haven, Conn.

J. B. Emerson, formerly employed as a chemist at a steel plant at Joliet, Ill., has accepted the position of chief chemist for the Mt. Vernon Car & Mfg. Co., Mt. Vernon, Ill.

DEATHS.

Mr. Geo. B. Anderson, head of the foundry firm of Geo. Anderson & Co., foundrymen of Jeffersonville, Ind., died at his residence in Jeffersonville on Sept. 21. Mr. Anderson was 65 years of age. The foundry firm of which he was the head was organized in 1840 by Mr. Anderson's father, C. C. Anderson, who died about 15 years ago. The cause of Mr. Anderson's death was quick consumption, resulting from a cold contracted last winter.

Thos. Maher, one of the pioneer foundrymen of Cleveland, died at his residence on Sept. 24. Mr. Maher had been seriously ill for about a week, the immediate cause of his death being heart failure. At the time of his death he was vice president of the Riverside Foundry Co. He was 74 years old and had lived in Cleveland 56 years. He learned the foundry business in this city and started into business with N. P. Bowler under

the firm name of Bowler & Maher. The firm was later Bowler, Maher & Brayton, and in 1880 the firm became Maher & Brayton. In 1896 Mr. Maher purchased Mr. Brayton's interest and formed the Maher Wheel & Foundry Co. Later this was sold to the National Car Wheel Co., at which time Mr. Maher retired from active business.

FIRES.

The foundry and lacquering departments of the Knickerbocker Brass Bedstead Co., at Kearny, N. J., were destroyed by fire on Sept. 27.

The brass foundry of the Kruecke Bros. Mfg. Co., of Milwaukee, Wis., was damaged by fire and water to the extent of $1,500 on Sept. 25.

The pattern storage warehouse, of Mackintosh, Hemphill & Co., Pittsburg, was destroyed by fire Sept. 18. The building was four stories, 170 x 30 ft., and was located on the river side of the plant, a strong wind blowing towards the river preventing other portions of the plant from taking fire. The work of the city fire department was not as effective as usual, there being delay in getting in an alarm and much trouble from bursting hose. It is stated the loss will be from $150,000 to $200,000 on the patterns, $30,000 on the building and $20,000 on the equipment, all covered by insurance. The patterns were well covered by drawings, and can all be replaced. The firm builds engines and rolling mill machinery.

The Wilson Foundry, of Wilson Village, N. Y., was destroyed by fire on Oct. 4. The loss is about $10,000.

The Chatfield Brass Foundry, at Escanaba, Mich., was seriously damaged by fire about the middle of September. The loss is estimated at $10,000, with insurance of $6,000. The plant will be rebuilt.

The Featherstone Foundry, of Chicago, was destroyed by fire on Sept. 14. A number of employes had a very narrow escape from the building. The patterns which were destroyed represented an accumulation of 30 years and will be a serious loss to the company.

The plant of the Capital Casting Co., of Lansing, Mich, was partially destroyed by fire on Sept. 15. The loss is fully covered by insurance.

The foundry of John Klenk, 1829 South Water street, Philadelphia, was damaged by fire on Sept 11 to the extent of $500.

The Excelsior Brass Works, of Reading, Pa., were damaged by fire to the extent of $3,000 on Sept. 16. The loss is covered by insurance.

A portion of the plant occupied by Jas. G. Newbury as an iron foundry and machine shop in Coxsackie, N. Y., was burned on Sept. 21. The loss was fully covered by insurance.

NEW CONSTRUCTION.

The additions to the works of the Worcester Steel Casting Co., of Millbury, Mass., have been completed.

The Athol Pump Co., of Athol, Mass., is erecting a brass foundry 30 x 30 ft.

Two additions, one 19 x 41 ft. and the other 21 x 23 ft. are being made to the plant of the Bridgeport Brass Co., of Bridgeport, Conn.

The Rhode Island Malleable Iron Works, Hills Grove, R. I., is moving one of its furnaces and building an addition which will require the employment of 25 additional molders.

The contract for the Shaw Machine Co.'s plant at Lowell, Mass, has been awarded to J. V. Bishop & Co., of Boston. The plant includes a foundry.

The Liberty Brass Foundry Co., of Buffalo, N. Y., has just purchased 78 ft. of land on Niagara street near Albany street, and will build a four-story brick factory on the site.

The No. 2 shop of the Goulds Mfg. Co., of Seneca Falls, N. Y., is to be greatly enlarged. The plans call for a foundry 144 x 340 ft., a pattern shop 130 x 42 ft. and 5 stories in height, an engine house 55 x 70 ft. and boiler house 72 x 50 ft., also a new office building.

A building permit has been taken out by the Isaac G. Johnson Co., of Spuyten Duyvil, N. Y., for the improvement of a one-story brick foundry building 150 x 152 ft.

The C. A. Lefferts Co., 128 Second avenue, Brooklyn, N. Y., has taken out a building permit for a brick foundry 90 x 200 ft. The work is in charge of H. Helder, architect, 242 Franklin avenue.

The H. Wales Lines Co., Meriden, Conn., has begun the construction of the new plant for the Henry-Bonnard Bronze Co., at Mount Vernon, N. Y. The foundry and fin-

ishing buildings will each be 76 x 227 ft. and the power house will be 43 x 74 ft. The larger buildings will be two stories in height.

Davidheiser & Wiand, contractors of Pottstown, Pa., are erecting a new foundry plant for Stanley G. Flagg & Co. of the same city. The new building is to be 100 x 240 ft. and will replace a structure 80 x 200 ft. which was burned last February. The work is now being carried on in a temporary foundry which was erected just after the fire.

The United States Furnace & Foundry Co., whose principal offices are in Pittsburg, has just completed the erection of a new plant at Darlington, Beaver Co., Pa. This plant will be equipped with all modern machinery and improvements, and will have a capacity of from 15 to 30 tons per day. The company manufactures a line of residence furnaces, apparatus for ventilating, etc., and expects to add a cast iron, hot water and steam boiler.

The foundry and boiler departments of the U. S. Radiator plant, McKeesport, Pa., are being enlarged.

The Tacony Iron Co., of Tacony, Phila., Pa., is erecting a new 40-ton foundry, which will be completed by Oct. 15.

R. B. Seidel, Inc., Philadelphia, Pa., has purchased the property adjoining his present plant and has erected a new office building upon it.

The Bucyrus Steel Casting Co., Bucyrus, O., expects to erect a new steel foundry building 130 x 300 ft., the contract for which will probably be let in the course of the next 30 days. The company will be in the market for complete equipment.

The J. B. Fate Co., of Plymouth, O., has broken ground for the erection of a foundry, 70 x 120 ft.

The Muncie Foundry & Machine Co., has decided to move its plant from the L. E. & W. Ry. lines and South Mulberry street, Muncie, Ind. The change results from cramped quarters in its present location. The company has several sites in view and will decide upon one of them soon. The new buildings, when erected, will be of brick and iron construction and modern in every way. It is said they will cost about $15,000. The company has petitioned the city to have a site in the eastern part of Muncie vacated for its new works.

The Frankfort Brass Works, of Frankfort, Ind., are constructing two additions to their plant, one being a foundry 32 x 50 ft. and the other a power plant 15 x 20 ft.

Reeves & Co., of Columbus, Ind., are constructing a new pattern building 40 x 70 ft.

The Western Foundry Co., Chicago, is preparing plans for a new foundry building 115 x 250, a cleaning building 60 by 272, and a core room 60 x 75. The necessary machinery has not yet been purchased. Bonds to the amount of $40,000 will be issued to cover the cost of the improvements.

The Glen Foundry Co., of St. Charles, Ill., is constructing an addition to its foundry which will give employment to 125 more men.

J. H. Emery will erect a foundry and machine shop at Bay City, Mich., for the manufacture of the Emery brick cement machine.

The American Pipe & Foundry Co., of Birmingham, Ala., which was recently organized, mainly with Atlanta capital, will soon begin the erection of a large plant at North Birmingham for the manufacture of cast iron pipe. The company has secured 30 acres of land and it is estimated at least $200,000 will be expended in fitting up the works.

W. J. Oliver, of Knoxville, Tenn., has announced that he expects to build a large foundry and a plant to make trolley cars. The foundry will be operated in connection with the W. J. Oliver Mfg. Co., which is also the name of the trolley manufacturing company.

The malleable iron foundry being built by the Western Steel Car and Foundry Co., at Anniston, Ala., is almost completed.

Moffatt Machinery Mfg. Co., Charlotte, N. C., is building a foundry and machine shop. W. E. Moffatt, formerly of Park Mfg. Co., is president and engineer of the company.

The Avondale Stove & Foundry Co., of Birmingham, Ala., has enlarged and practically rebuilt its plant. The Messrs. Ellis bought the works and took possession last December, at which time the capacity was 30 stoves per day. It is now 80 and will be increased to 100. The works have been equipped with modern machinery throughout. Perkins Ellis is president; Thomas Ellis is secretary and Frank F. Ellis is treasurer.

It is reported that the Cloverport Foundry & Machine Co., of Cloverport, Ky., is erecting an addition which will be used for the manufacture of stoves.

The new plant of the Davis Foundry & Machine Works, of Rome, Ga., will be com-

pleted in 60 days from the time work started. This will be about December 1.

The Southern Co-operative Foundry Co., North Rome, Ga., is building a new foundry, making additional molding space 40 x 60 ft. and 70 x 136 ft. It is also erecting an additional 2-story building 70 x 135 ft. for stove mounting and manufacturing steel ranges.

J. E. Goens, Roanoke, Va., is building a foundry 60 x 120 ft. for general jobbing.

The Anniston Foundry & Machine Co., of Anniston, Ala., has contracted for the erection of an addition to its plant, to be used in the manufacture of soil pipe fittings.

The Mobile Foundry Co., of Mobile, Ala., has taken out a building permit for a $2,000 building.

The Fulton Foundry & Machine Co., of Atlanta, Ga., has erected foundry and machine shops, each 120 x 200 ft., and a large pattern shop and store room at a cost of about $125,000. Modern equipment is being installed, with the intention of turning out a heavy class of work.

The construction of the foundry building of the Fisher Machine Works, of Leavenworth, Kan., is being pushed rapidly and the plant will soon be ready for the machinery.

President C. A. Kuenzel, of the Buena Vista Ore Buying & Smelting Co., Buena Vista, Colo., announces that the company will erect a smelter and also a foundry at Buena Vista, Colo.

The repair shops of the Los Angeles-Pacific at Sherman, Cal., are to be enlarged, several new buildings being constructed. They will include a foundry 36 x 100 ft.

The Oregon Short Line is planning to erect a large foundry in connection with its repair shops at Pocatello, Idaho.

The plant of the Tulsa Foundry & Machine Co., of Tulsa, I. T., is to be doubled in capacity.

In addition to its new machine shop which the Hercules Gas Engine Works is erecting at San Francisco, Cal., a new foundry plant will be constructed at once. The new site affords abundant wharf facilities and a medium sized marine railway has been installed. Draftsmen and patternmakers are rapidly replacing the designs of patterns destroyed in the recent fire.

T. D. Dickson, of McKeesport, Pa., has purchased a site at St. John, Kan., for a large foundry and machine shop.

The Fairbanks-Morse Canadian Mfg. Co., of Toronto, Can., has taken out building permits for a foundry and a blacksmith shop.

Forwell Bros., of Berlin, Ont., are preparing the plans for a foundry which will require several buildings, one 52 x 100 ft. and another 35 x 100 ft. In addition there will be a stock shed 20 x 65 ft. and a metal supply shed 18 x 115 ft.

GENERAL INDUSTRIAL NOTES.

The Beaver Dam Malleable Iron Co., Beaver Dam, Wis., held its annual meeting recently and elected the following officers: S. W. Lamoreux, president; Peter Beule, vice president; E. S. Mason, secretary; D. P. Lamoreux, treasurer, and J. E. Fischer, superintendent.

The High Point Pipe & Foundry Co., of High Point, N. C., has started up its foundry and made its first shipment of pipe on Aug. 29.

The plant of the Southern Car & Foundry Co., at Gadsden, Ala., has been formally transferred to the Alabama Great Southern R. R. Co. by Thos. G. Bush and Orlan L. Hurlbut, who were in charge of the plant. The purchase price was $16,000.

W. L. Sherwood has purchased the machinery and stock of the Kirksville foundry, of Kirksville, Mo.

The first heat in the Williams Bros.' Foundry, at Marshalltown, Ia., was run on Sept. 4.

The Banner Stove & Mfg. Co., of St. Louis, Mo., has been incorporated with a capital of $10,000. The incorporators are: James H. Howe, Arthur G. Hildreth and Wm. H. Eckert.

The Schaahe Machine Works, of New Westminster, B. C., have just completed an extension to their foundry, which has been necessary on account of the large number of orders received for rock crusher jaws made from Emett's Hardite.

The Wallaceburg Brass & Iron Mfg. Co., Ltd., has been registered in Toronto, Canada, with a capital of $40,000.

The Northwest Stove Foundry, of Salem, Ore., is closed for a couple of months, during which time the building will be extensively repaired, including a new roof, cement floor and other improvements.

Plans are on foot for the remodeling of the Oklahoma Foundry, of Guthrie, Okla. The intention is to add to the plant in order to manufacture a line of wind mills and stoves

and other products which can be disposed of in that region.

Samuel Thompson & Co., Ltd., Millfields, near Wolverhampton, Staffordshire, have been registered to carry on the business of iron founders, mechanical engineers, manufacturers of agricultural implements and other machinery, toolmakers, etc. The first directors are: S. Thompson, J. McEwen, and G. B. A. Gibbons. The capital is £25,000.

Yates & Thom, Ltd., with a capital of £240,000, has been registered to carry on the business of iron founders, boilermakers, mechanical and electrical engineers, machine and tool makers, brass founders, smelters, coppersmiths, etc. The first directors are: W. Yates, W. Thom, W. Thom Jr., H. Thom, and F. Thom. The registered office is the Canal Engineering Works, Blackburn, Lanc., England.

Cross Bros., Ltd., has been organized with a capital of £60,000 to acquire the business of ironmongers, iron merchants, furnishers and general dealers carried on at 3-4 St. Mary street and 21-23 Working street, Cardiff, Glamorgan. The business of metal-founders, boilermakers, agricultural implement manufacturers and merchants, gunsmiths, dealers in chains, anchors and shipping appliances will also be carried on. The first directors are: C. Cross, E. E. Cross and T. N. Cross.

The St. John N. B. Foundry Co., St. John, N. B., are to double the capacity of their stove foundry.

J. Hartman, of Tampico, Mexico, will establish a modern foundry and machine shop in the near future.

The new foundry of West Bainbridge, Ga., controlled by D. T. Sutherland, is to include a machine shop 50 x 50 ft., pattern shop 25 x 50 ft., boiler and engine room 40 x 50 ft., all of iron and brick. Orders for the new engine and boiler, boiler and feed pump, heater and various machine shop tools will be placed in the near future. The building material has already been placed.

The new plant, including the foundry, of the White-Warner Co., of Taunton, Mass., was started on Sept. 25. The old plant occupying the same site was destroyed two years ago, after which the company secured another plant by purchase, but having outgrown its adopted home, has had to rebuild its old plant so that it can be used in connection with the existing one.

The Moore Facing Works, of Providence, R. I., have moved from their old location to 143 Allens avenue. Since the death of Mr. John A. Moore, the business is directed by Mr. J. W. Moore.

Arthur C. Milot and Joseph Hoyle, of Woonsocket, R. I., have purchased the City Foundry at the corner of Pond and Snow streets. The plant will be improved and operated in connection with the Joseph Hoyle Bobbin Co.

The James Brown Machine Co.'s foundry of Pawtucket, R. I., has been closed for an indefinite period.

The new foundry at the Stanley Works, Morningside, Pittsfield, Mass., has just been put in operation.

The Snow Steam Pump Works, Buffalo, N. Y., recently made a casting weighing 170,000 lb. to be used as a bed plate by California Gas & Electric Corporation. Seven other such castings are to be made.

Geo. A. Ricker has been elected president of the Buffalo Testing Laboratory, Prof. N. W. Shed, vice president, and F. W. Turner, secretary. This is a new company with offices at 702 Ellicott Square and a laboratory at East Ferry street. It is proposed to carry on general testing and analytical work, including electrical testing. The development of the manufacturing interests in Buffalo has been so great that an establishment of this sort will offer advantages hitherto lacking in the city.

The Raquette Foundry & Supply Co., of Potsdam, N. Y., has been incorporated with a capital of $5,000, to carry on a general foundry business. The incorporators are Geo. D. Huntington, and G. S. Knowlton, of Waterford, N. Y., and Alex. R. O'Neill, of Potsdam, N. Y.

The Syracuse Aluminum & Bronze Co., of Syracuse, N. Y., which was recently organized with Alexander T. Brown and W. C. Lipe as the principal stockholders, has leased the plant of the old Stearns Vehicle Co., on Leavenworth avenue and will make a specialty of large aluminum castings.

T. H. Townsend has purchased the interest of Albert D. Kimball in the Waterville Foundry & Mfg. Co., of Waterville, N. Y., and Mr. Townsend is now sole owner of the plant.

For additional Industrial Notes see page 71 of the advertising.

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